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VOL. CXLVIII.—No. 3858] LONDON: FRIDAY EVENING, DECEMBER 20, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Royal Air Force

EDUCATIONAL SERVICE.

APPLICATIONS are INVITED for VACANCIES as CIVILIAN EDUCATION OFFICERS in the Royal Air Force Education Service. Candidates should have a good degree in engineering, physics, or mathematics. Other things being equal, preference will be given to ex-Service candidates and those with previous teaching experience.

The appointments will be made to Grade III., the scale of salary of which is £234-£15-£480, with an allowance varying from £60 to £100 per annum, according to the position on the scale. For entrants with appropriate previous experience commencing salaries up to ten increments above the minimum of the scale may be allowed. Promotion to appointments in higher grades is by selection.

The form of application and a copy of the regulations for the Educational Service may be obtained from the SECRETARY, Air Ministry, Gwydyr House, Whitehall, S.W. 1. Applications should be returned as early as possible. 4015

The Institution of Mechanical Engineers.

THOMAS LOWE GRAY LECTURE, 1930.

Eng. Vice-Admiral R. W. SKELTON, C.B., C.B.E., D.S.O. (Member of Council), will deliver the above Lecture on "PROGRESS IN MARINE ENGINEERING," at the Institution, Storey's-gate, Westminster, on Friday, 3rd January, at 6 p.m. VISITORS ARE INVITED.

The Lecture will be repeated in Glasgow on 9th January, in Liverpool on 16th January, and in Bristol on 22nd January. 3993

In the Matter of LETTERS PATENT granted to JOHANNES CARL RUTHS dated 18th March, 1914, and numbered 6894/1914 for the invention of a Method of Compensating the Supply of Heat in relation to Steam Consumption in Steam Generators.

Notice is Hereby Given that on

the 21st January 1930 an ORIGINATING SUMMONS (1929 R. No. 1786) issued out of the High Court of Justice (Chancery Division) on behalf of Johannes Carl Ruths and Ruths Accumulator A.B. (the Patentees) asking that the term of the Patent may be extended for a further period of 5 years will come before Mr. Justice Luxmoore for directions and any person desirous of being heard in opposition must at least seven days before that date lodge NOTICE OF OPPOSITION (giving an address for service within the United Kingdom) at Room 175, Royal Courts of Justice Strand London and serve a copy thereof upon the undermentioned Solicitors and upon the Solicitor to the Board of Trade.

Dated the 19th day of December 1929.

FIELD ROSCOE and CO., 36, Lincoln's Inn Fields, London, W.C. 2, upon whom all documents requiring service should be served. 4021

Administrative County of LONDON.

The London County Council invites APPLICATIONS for TWO APPOINTMENTS on the permanent staff as ASSISTANT in the First Class (Technical) in the Chief Engineer's Department. Candidates, if not already in the Council's service, must be under 40 years of age on 7th January, 1930, and must be Corporate Members of the Institution of Civil Engineers or have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or have taken a degree recognised by the Institution as exempting therefrom. They must have had experience of surveying and levelling and of the design and construction of civil engineering works, e.g., road, sewer and bridge work. The scale of salary attaching to the appointments is £250 a year (based on pre-war conditions), rising by £15 annually to £310 a year, thence by £20 annually to £350 a year. With present temporary fluctuating additions the remuneration is about £361 to £485. The next revision of the temporary additions is due to take place not earlier than 1st January, 1930.

Applications must be made on the official form, copies of which (with full particulars) may be obtained by sending a stamped addressed foolscap envelope (marked "Engineering Assistant") to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1.

Forms must be returned by 7th January, 1930. Canvassing disqualifies.

MONTAGU H. COX,
3957 Clerk of the London County Council.

Government of Northern IRELAND.

NOTICE TO ENGINEERING AND DREDGING CONTRACTORS.

BANN DRAINAGE WORKS, NORTHERN IRELAND.

The Ministry of Finance invites TENDERS for extensive DEEPENING and WIDENING, through rock and other materials, of the LOWER BANN RIVER over its whole course of approximately 30 miles between Lough Neagh and the tidal portion of the river near Coleraine, Co. Londonderry; and for CONCRETE CONSTRUCTION WORKS in connection with the installation of Three Sets of Flood Gates of the Stoney Type, together with AUXILIARY WORKS for Navigation and Fisheries.

The drawings, conditions of contract, specification and bills of quantities will be on view at the office of the Ministry's Director of Works, 113, Royal-avenue, Belfast, from 20th December, 1929, to 20th February, 1930, and at H.M. Office of Works, Storey's-gate, Westminster, London, S.W. 1, from 1st to 31st January, 1930, inclusive.

"Instructions to persons tendering," the form of Tender, the conditions of contract, the specification, and bills of quantities can be obtained on written application to the Secretary, Ministry of Finance, at 15, Donegall-square West, Belfast, on payment of a deposit of £50, which deposit will be returned only on receipt of a bona fide Tender. No Tender will be considered unless the "instructions to persons tendering," are fully adhered to, and unless accompanied by the bill of quantities fully priced in ink, showing the rate for each item. Envelopes containing Tenders are to be addressed to the Secretary, Ministry of Finance, 15, Donegall-square West, Belfast, and marked "Tender for the Bann Drainage Scheme." Tenders with bills of quantities will be received up to but not later than 3 p.m. on the 20th day of February, 1930.

Each Tender should be accompanied by a statement setting forth the contracts which have been undertaken by the parties tendering for the past six years. The statement should also give particulars of works similar to that specified which may have been carried out in the past by the parties tendering, together with the names and addresses of the engineers under whose supervision the works have been performed.

The Ministry is not bound to accept the lowest or any Tender.

R. E. THORNLEY,
Assistant Secretary.
Ministry of Finance, Belfast,
11th day of December, 1929. 3987

The Engineer

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PUBLIC NOTICES

Caledonian Collieries, Ltd.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY and ERECTION of

BOILER PLANT

for Cockle Creek Power Station, near Newcastle, New South Wales.

Specification may be obtained from
HOWARD SMITH, LIMITED,
33, Cornhill, London, E.C. 3. 4010

County Borough of Preston.

WATERWORKS.

The Corporation invite TENDERS for the SUPPLY during 1930 and 1931 of about 7 MILES of 30in. diameter STEEL WATER PIPES with Bituminous Lining and Hessian Cloth Wrapping.

Specification and form of Tender may be obtained from the office of the Water Engineer, and applications should be accompanied by a remittance of One Guinea, which will be returned upon receipt of a bona fide Tender for the work.

Sealed Tenders, endorsed "Water Pipes," addressed to the Water Engineer, Tithebarn-street, Preston, should be delivered before Twelve Noon on Saturday, the 4th January, 1930.

The Corporation do not bind themselves to accept the lowest or any Tender.

ALFRED HOWARTH,
3988 Town Clerk.

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for :—

500 STEEL TYRES FOR CARRIAGES AND WAGONS.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's Offices not later than Noon on Tuesday, 7th January, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Secretary.
18th December, 1929. 4014

PUBLIC NOTICES

South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

MADRAS IMPROVEMENTS—ELECTRIFICATION.

1. CABLES and ACCESSORIES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked : "Tender for Cables and Accessories" with the name of the firm tendering, must be left with the undersigned not later than 12 Noon on Friday, the 24th January, 1930.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1.
18th December, 1929. 4022

Teddington Urban District COUNCIL.

SEWAGE DISPOSAL WORKS.

CONTRACT NO. 5.

SLUDGE PRESSES, &c.

The above Council invite TENDERS for the SUPPLY and ERECTION complete of additional SLUDGE PRESSES and SLUDGE PUMP, together with appurtenant WORK thereto, including REPAIRS to existing PUMP and various STRUCTURAL ALTERATIONS.

Plans may be seen and specification and further particulars obtained at the office of the Surveyor, Mr. E. Bostock, on deposit of One Guinea, which sum will be returned upon receipt of a bona fide Tender.

Tenders, sealed and endorsed "Sewage Disposal Works—Contract No. 5," should be sent to me, the undersigned, not later than Noon on Thursday, the 9th January, 1930.

The Council do not bind themselves to accept the lowest or any Tender.

F. E. READ,
Clerk of the Council.
Council Offices, Teddington,
18th December, 1929. 4017

PUBLIC NOTICES

Borough of Twickenham.

CLERK OF WORKS.

APPLICATIONS are INVITED for the APPOINTMENT of a CLERK OF WORKS to Supervise Sewerage Contracts, comprising the Construction of Sewers, Reconstruction of Buildings and Tanks, and the Erection of Pumping Machinery. Salary £6 6s. a week.

Applications, stating age, previous experience, and accompanied by copies of recent testimonials, to be sent to Messrs. William Fairley and Co., Consulting Engineers, Parliament Mansions, Victoria-street, Westminster, S.W. 1, not later than Saturday, 28th December, 1929.

EDWIN G. STRAY,
Town Clerk.
Municipal Offices, Twickenham,
16th December, 1929. 4012

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, SALESMAN for Grinding Wheels, indoor and outdoor. Technical and practical knowledge necessary, also knowledge of French an advantage.—Address, stating qualifications, salary, &c., P6485, The Engineer Office. P6485 A

WANTED, SHOPS MANAGER, with First-class experience in both Mechanical and Electrical Engineering, also with up-to-date knowledge of Machine Shop, Erecting Shop and Testing Department practices.

Please address, with copies of references, stating full experience, age and salary required, 3999, The Engineer Office. 3999 A

AN ENGINEERING ASSISTANT is REQUIRED in the Research Department of a large English Engineering Firm. Candidates should be graduates in physics or engineering, and, whilst some works experience is desirable, it is not considered essential. The work would be of a general character, but a knowledge of the fundamentals of heat transmission and fluid motion would be an advantage, and applicants should refer to their experience in these matters.—Full particulars of qualifications, training and experience, with copies of recent testimonials, should be addressed 3992, The Engineer Office. 3992 A

ASSISTANT TECHNICAL MANAGER REQUIRED, with first-class experience Condensing, Evaporating, De-aerating and Feed Heating Installations for land and marine use, to take full responsibility for design and control drawing-office. Salary £500 to £650 per annum, according to qualifications. State age, full particulars of experience, salary required, and when at liberty. Replies will be treated in strictest confidence.

Address, P6511 The Engineer Office. P6511 A

CHEMICAL ENGINEER.—A Large ENGINEERING FIRM REQUIRES the SERVICE of a SENIOR CHEMICAL ENGINEERING DRAUGHTSMAN. He will be required to take charge and develop the "chemical plant" section, be able to conduct sales correspondence, and to secure a definite quotum of orders for heavy plant. The fullest particulars, including salary required, to be stated.—Address, 3938, The Engineer Office. 3938 A

ENGINEER, About 27-30, REQUIRED by Large London Company trading in Tropics, view train in London office, then in Tropics, then make headquarters London, with periodical visits Tropics to supervise maintenance and developments. Good technical man with varied all-round experience essential. Must be Mechanical Engineer. Knowledge structural design, building construction, civil, marine and electrical are recommendations. To be considered, replies must clearly state age, probable salary required home and abroad, full details technical qualifications and experience, also give copies all references.—Address, "G. S.," c/o Street's, 6, Gracechurch-street, London, E.C. 3. 4013 A

ENGINEER (Junior) for Estimating Department, with experience Air Filters, Ventilation Plant, Correspondence, by London Engineering Company. State fully age, training, experience, salary required. No others considered.—Address, 3989, The Engineer Office. 3989 A

FOR Head Office, London, Highly Trained ENGINEER, with good knowledge Electro-chemical and Chemical Industries, to organise and manage works production and sales. Drive, initiative and experience in control of expert staff essential; must be alert business man as well as sound engineer.—Address full qualifications and salary required, 4011, The Engineer Office. 4011 A

PUPIL.—VACANCY in Office of Well-known Heating Engineer for YOUNG GENTLEMAN, matriculated.—Address, P6506, The Engineer Office. P6506 A

RATE-FIXER REQUIRED AT ONCE in London for General Engineering Factory engaged on very high-class production.—Address, stating age, experience, giving names of previous employers in date order, and salary required, 3961, The Engineer Office. 3961 A

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REINFORCED CONCRETE DESIGNER REQUIRED, with at least three years' experience in Specialists' Office.—Write, stating age, experience, and salary required, to INDUSTRIAL CONSTRUCTIONS, Ltd., 54, Victoria-street, Westminster, S.W. 1. 4005 A

REQUIRED, TWO JUNIOR SALESMEN, One for Midlands, the other for London, preferably with experience in the sale of Boiler-house Specialities. Men with experience of Water-tube Boilers and Combustion preferred.—Address, 3985, The Engineer Office. 3985 A

TEMPORARY ASSISTANT ENGINEER REQUIRED on Re.ervoir Construction Work. Must have had experience in Surveying and Levelling, and Plotting same, Setting Out Works, and Taking Out Quantities. Must be good draughtsman. Salary £5 5s. per week.—Applications, stating age, experience, and copies of testimonials, to be delivered on or before 31st December, 1929, to ENGINEER, Fylde Water Board, Blackpool. 3996 A

YOUNG Energetic OUTSIDE SALESMAN REQUIRED by firm commencing as Motor, Motor Cycle, Accessories and General Engineering Factors in London. Preference will be given to men with knowledge of the trade and engineering. Good opportunity for an ambitious young man ready to work hard.
Address, P6512, The Engineer Office. P6512 A

WELL-EDUCATED Smart and Energetic Young MAN, with engineering training and good knowledge of Motor Cycle Trade, REQUIRED by City Export Merchants for the POST as ASSISTANT GENERAL MANAGER and SALES ORGANISER. Knowledge of German essential. French desirable. Must have some commercial experience, correspondence, general office routine, shipping. Good prospects for suitable person. Persons only with highest personal testimonials need apply.—Address, P6513, The Engineer Office. P6513 A

WORKS ENGINEER REQUIRED for Large Manufacturing Firm in Lancashire (not engaged in engineering), to Take Charge of Machinery and men on production; must be good organiser and capable mechanical engineer. Works maintenance engineers need not apply. Applicants to enclose copies of recent testimonials and to state age, experience and salary required.—Address, 3932, The Engineer Office. 3932 A

WANTED, Good MECHANICAL DRAUGHTSMAN, knowledge of Coke Oven Machinery an advantage.—State age, experience, and salary required to JAMES BUCHANAN and SON (LIVERPOOL), Limited, Caledonia Foundry and Engine Works, Liverpool, N. P6510 A

CAPABLE MECHANICAL DRAUGHTSMAN WANTED for Steel Works near Middlesbrough.—Address full particulars of experience, qualifications, age, and salary required, 4019, The Engineer Office. 4019 A

CHIEF or LEADING DRAUGHTSMAN REQUIRED, with Steam Wagon or Heavy Petrol Lorry experience. Must be capable of taking full charge. Salary £350 per annum or upwards according to experience and ability.—Address, 4002, The Engineer Office. 4002 A

DRAUGHTSMAN.—Fully Competent MAN REQUIRED, used to designing and detailing Steam and Electric Jib Cranes, &c.—Apply, with full particulars of experience and salary required, to H. J. COLES, Ltd., London Crane Works, Derby. 3958 A

DRAUGHTSMAN, Jig and Tool, WANTED AT ONCE.—Apply, giving all particulars, to WORKS OFFICE, Westwood Works, Peterborough. 4006 A

YARROW HOME and HOSPITAL
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In these days of high cost of living, people of limited means are sometimes placed in a difficulty when their children are ill or need operations and afterwards require a change of air and much careful attention during convalescence. It cannot be too well known that the Yarrow Home and Hospital for Children, Broadstairs, Kent, was founded specially for the children of those who are not too well endowed with this world's goods. At this Home a child recovering from illness or an operation, or needing a long course of medical or surgical treatment, receives, amid the happiest possible surroundings and companionship, careful nursing and attention, such as could ordinarily only be obtained at expensive nursing homes. There are beds for fifty boys between the ages of four and twelve years, and for fifty girls between the ages of four and fourteen years. In special cases these age limits may be exceeded by two years. The fee is one guinea per week and travelling expenses. Applications for the entrance of patients are welcomed from professional people, such as members of the Institution of Civil Engineers, architects, artists, authors, clergymen, members of the medical, legal, and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the merchant navy, school masters, university professors, &c. The London office is at 116, Victoria-street, Westminster, and the Secretary will be pleased to send full particulars to anyone who is interested.

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED for General Engineering Works in the Midlands. Must possess sound experience of Reciprocating Pump design. State particulars, age, and salary required.—Address, 4000, The Engineer Office. 4000 A

DRAUGHTSMAN REQUIRED by Midland Firm. Must have sound knowledge of Road Appliances, such as Tarring and Gritting Machines. State full particulars, age, and salary required.—Address, 4001, The Engineer Office. 4001 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, London. Must be used to Furnace Design and Gas Producer Work. Excellent prospects for right man. State age, experience, and salary required.—Address, 4008, The Engineer Office. 4008 A

DRAUGHTSMAN REQUIRED. Progressive Opening for a live man with knowledge of Heavy Oil Engines.—Address, giving age, qualifications, and salary required, 3939, The Engineer Office. 3939 A

DRAUGHTSMAN, Senior, with Good Experience of A.C. and D.C. Motors and Generators.—Address applications, stating age, experience, and salary required, 3962, The Engineer Office. 3962 A

DRAUGHTSMAN, Used to Light Steel Work and Metal Windows.—Write, stating age, experience, and salary required, B., Tower Works, West Croydon. P6501 A

DRAUGHTSMAN WANTED by Makers of All Kinds of Hand-operated Lifting Tackle, including jacks, blocks, winches, &c. Must have experience in similar work.—Address, stating age, experience, and salary required, 4018, The Engineer Office. 4018 A

FIRST-CLASS AERO-ENGINE DRAUGHTSMEN and CHECKERS REQUIRED.—Write, stating age, experience, and salary required, to FRANK B. HALFORD, 9, Golden-square, London, W. 1. P6509 A

SITUATIONS OPEN (continued)

JUNIOR DRAUGHTSMAN WANTED for Structural Steel Work.—Apply, COCKSEDGE and CO., Ltd., Ipswich. 4016 A

STRUCTURAL DRAUGHTSMAN for London, with experience in design of Overhead Transmission Lines; some commercial experience an advantage.—Address in confidence, stating age, experience in full and salary required, P6508, The Engineer Office. P6508 A

TWO DRAUGHTSMEN REQUIRED IMMEDIATELY, experienced in design and construction of Steel Work for Large Sluices and Lock Gates. Only qualified and experienced applicants considered. State age, training, experience, salary required.—Address, 3995, The Engineer Office. 3995 A

JUNIOR DRAUGHTSMAN REQUIRED in London, with experience in Steam-raising Plant and Accessories.—Address fully, 4007, The Engineer Office. 4007 A

WANTED, a FOREMAN for Machine Shop. Must be a first-class man, smart and efficient in up-to-date methods; must be good timekeeper and capable of thoroughly controlling men and well up in fixing piecework prices.—Apply by letter in first instance, giving full particulars of experience, age, and salary expected, to WORKS MANAGER, Spencer (Melksham), Ltd., Melksham, Wilts. 4004 A

WANTED, FOREMAN PLATER for Structural Shop in Crane Works. The applicant must be a good organiser and energetic, having held similar position in a structural shop. Applicants to state age, experience, and salary required.—Address, 3998, The Engineer Office. 3998 A

FOUNDRY FOREMAN (WORKING) WANTED for Small Foundry in the Midlands, output 5/6 tons per week.
Must be thoroughly practical in all branches, capable of taking full control, and good disciplinarian. Full particulars and wages required.
Address, P6516, The Engineer Office. P6516 A

SITUATIONS OPEN (continued)

FOREMAN MOULDER WANTED, Accustomed to Large Green and Dry Sand Castings up to 20 tons. State age, experience, and salary required.—Address, 3991, The Engineer Office. 3991 A

WANTED, RADIAL DRILLING MACHINE OPERATORS. Must be used to accurate work on Steel Castings.—Reply to the NATIONAL STEEL FOUNDRY (1914), Limited, Kirkland Works, Leven, Fife. 3974 A

WANTED, TURNERS or MACHINISTS, Experienced in operating Bullard Vertical Boring Mills or similar Machines. Must have experience of Steel Castings.—Reply to the NATIONAL STEEL FOUNDRY (1914), Limited, Kirkland Works, Leven, Fife. 3976 A

WANTED, VERTICAL MILLING MACHINE OPERATORS. Must be used to handling Steel Castings.—Reply to the NATIONAL STEEL FOUNDRY (1914), Limited, Kirkland Works, Leven, Fife. 3977 A

TURNERS or MACHINISTS WANTED, to Operate Herbert No. 9 or 20 Combination Turret Lathes. Must be used to Steel Castings.—Reply to the NATIONAL STEEL FOUNDRY (1914), Limited, Kirkland Works, Leven, Fife. 3975 A

SITUATIONS WANTED

CLERK.—MIDDLE-AGE MAN REQUIRES SITUATION, London. Shorthand, typewriting, filing, telephone. Many years engineer's office.—Address, P6514, The Engineer Office. P6514 B

DRAWINGS.
Designs, Layouts, Details Worked up by Mechanical Engineer with European and American experience. Special attention to rush work. Monetary guarantees and references given in cases of confidential design and records.—Address, P6503, The Engineer Office. P6503 B

ENGINEER DRAUGHTSMAN OFFERS Following EXPERIENCE:—Engine, boiler design, factory, plant, power station design and layout, including viscose and acetate silk, cellulose acetate. Wide mechanical experience; specialist in pipe work. Age 30.—Address, P6504, The Engineer Office. P6504 B

ENGINEER (26), Experienced in Erection and Maintenance of power plant, DESIRES SITUATION, home or abroad; some knowledge of Spanish.—Address, P6515, The Engineer Office. P6515 B

EXPERIENCED ENGINEER, at Present Chief Engr. industrial concern, salary £750, WISHES POSITION as MANAGER. Age 42. Unimpeachable record.—Address, P6421, The Engineer Office. P6421 B

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INDUSTRIAL ENGINEER, Age 30. Shops, D.O., and foreign experience, B.Sc., SEEKS POSITION with prospects. Would make good assistant to consulting engineer.—Address, P6502, The Engineer Office. P6502 B

For continuation of Small Advertisements see page 4.

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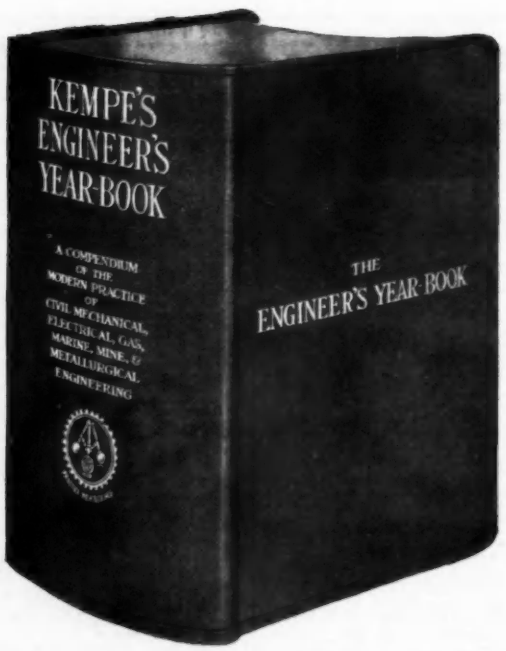

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A Seven-Day Journal

Pneumatic Drills and Road Repairs.

LIKE many other bodies and individuals, the Westminster City Council is concerned about the clamorous noise which is emitted by the pneumatic drills and air compressors employed on street repairs. The Council's Works Committee has received many complaints on the subject, and has been seeking what help it could towards some plan for mitigating the nuisance. It does not appear to have achieved any great success in its search for relief. The Department of Scientific and Industrial Research did not feel able, when approached by the Committee, to institute investigations on the subject on the ground that there must already be sufficient information and experience available to enable designers to deal with the problem, subject to the requisite incentive to tackle it being forthcoming. The Department's view apparently is that the problem in its main elements is a financial rather than a scientific one. A paving contractor told the Committee that a compressor taking four drills not fitted with silencers could only take three with silencers, and that, consequently, the noise avoided by the use of silencers on the drills would be overbalanced by the extra noise of an additional compressor. This argument seems to us to be based on the curious assumption that it is impossible to fit a silencer to the compressor. The City Engineer reported to the Committee that while some makers claimed to have produced a successful silencing device for the drills, the problem had not yet been completely solved. The fact is that a considerable amount of the noise comes not from the compressor or from the exhaust of the drills, but from the hammer blow of the bits on the concrete, and it is not clear how that component of the total noise is ever going to be suppressed. The Committee intends to keep the question before it, but while the noise is a nuisance, the saving of time resulting from the use of pneumatic drills is so considerable that it cannot see its way clear to recommend the Council to revert to the use of the hand pick and hammer method of former times.

Long-Distance Flight Attempt.

AT 8 a.m. on Tuesday, December 17th, the Fairey-Napier long-distance monoplane left Cranwell Aerodrome on an attempt to fly non-stop to Cape Town, a distance of 6000 miles, and to break the world's non-stop long-distance record of 4912 miles, held by France. The pilots were Squadron-Leader Jones-Williams and Flight-Lieutenant Jenkins. Flying the same machine, these two pilots on April 24th left Cranwell on a previous attempt to break the record, but after being in the air for 50 hours 38 min. and covering a distance of 4250 miles, they were forced to alight at Karachi, their petrol supply having become exhausted as a result of the very unfavourable weather which they encountered. On Tuesday the machine took off successfully from the specially prepared track, its total weight being about 7¼ tons. The fuel, carried in tanks in the wings, amounted to more than a thousand gallons. The machine was fitted with a wireless transmitting set working on a wave length of 33·71 m., and it was arranged that it should report its position every four hours. At 12 noon on Tuesday it was 12 miles south-east of Nevers, on the Loire, in Central France, and at 4 p.m. on the same day it was 50 miles off the north-west coast of Sardinia. No messages were received from the machine at 8 p.m. and at midnight. Late on Wednesday night it became known that the machine had crashed in the mountainous region south of Tunis and that both the pilots had been killed.

Millfields Road Power Station.

THE Electricity Committee of the Metropolitan Borough of Hackney has unanimously recommended its Council to accept the tender submitted by Simon-Carves, Ltd., boiler engineers, Manchester, for the extensive additions to the boiler plant, which are to be carried out at the Council's Millfields-road generating station. The contract comprises the installation of three water-tube boilers, each having an evaporative capacity of 125,000 lb. to 150,000 lb. of steam per hour, travelling grate mechanical stokers, economisers, superheaters, mechanical draught plant, and an independent chimney to each boiler. The contract also includes the whole of the foundations and civil engineering work, a new steel-framed brick boiler-house, capable of accommodating six boilers of the size stated, and coal-handling and storage plant of sufficient capacity to deal with the full equipment of boilers. The total value of the boiler plant contract is about £250,000. The boilers will be of the Simon-Carves multiple-drum type, with water-wall combustion chambers and water-cooled stoker arches. The ashes will be removed from the boilers by sluicing them to an underground pit, from which they will be transferred by electrically operated grabs to an overhead bunker for delivery to barges. The coal-handling plant will comprise electrically driven transporters arranged for unloading coal by means of grabs from barges on the River Lea Navigation, and weighing and transporting it to overhead storage bunkers in the boiler-house or to a large storage yard at the rear of the station. The boiler-house bunkers will have a storage capacity of 2000 tons of coal. A new central control room for the boiler plant, a laboratory, and mess-rooms for the staff are included in the contract. The new boiler plant forms part of the big extension which is to be carried out at Millfields generating station under the national electricity scheme.

H.M. Airship R 100.

ON Monday, December 16th, the airship R 100, built at Howden, Yorkshire, by the Airship Guarantee Company, to the order of the Air Ministry, was successfully brought out of her shed and after a flight lasting nearly six hours was flown to Cardington and safely moored to the tower. The actual journey of about 140 miles from York to Cardington was accomplished in a little over two hours. The mooring operations at the tower occupied three-quarters of an hour. Including the crew, sixty-eight people were on board the vessel during the trip. It was intended that the ship should remain at the tower for forty-eight hours, as in the case of R 101, to permit certain tests to be conducted while she was at anchor. On Tuesday, however, she was taken on a six hours' cruise over the Bedford area for the purpose, so it is reported, of examining the behaviour in flight of the fabric of one of the tail surfaces. On returning to the tower she was moored in the record time of thirty-two minutes. On Wednesday the airship was taken from the tower into the second shed at Cardington for adjustment of the fabric covering. It may be recalled that in R 100 the fabric is tautened by internal pull, whereas in R 101 the tautening arrangements involve an internal push.

The Steel Industry and the Coal Marketing Scheme.

PRESIDING on Tuesday at a meeting of the shareholders of Dorman, Long and Co., Ltd., Sir Arthur Dorman drew attention to an aspect of the Government's coal marketing scheme which has probably so far escaped general notice. The scheme, Sir Arthur said, was devised to enable the coalowners to obtain increased prices for their output, in order to meet the extra costs imposed on them as a result of the shorter working hours and other provisions of the Coal Mines Bill. Messrs. Dorman Long's collieries had been acquired in order to obtain control over the supply of fuel for their own iron and steel works, and could not therefore charge an increased price for their output. Yet they would apparently have to meet the increased costs entailed by the reduction of hours, the increased wages and the restriction of output enforced by the Bill. It seemed clear, therefore, that unless the company was allowed to supply its own requirements of fuel from its own collieries without restrictions, the Government's proposals would do serious damage to the already hard-pressed iron and steel industry. The position is undoubtedly a serious one, for several other large iron and steel producers besides Dorman, Long and Co. draw their fuel supplies from their own collieries, and are therefore not in a position to obtain increased prices for their fuel output without adding to the prices charged for their output of metal. It appears that 24 per cent. of the entire output of the Durham coalfield is used in the production of iron and steel, and consequently any enforced increase in the cost of fuel will react gravely on the iron and steel industry, already fully taxed to compete with continental makers.

A Beam Wireless Station for Plymouth.

To assist the navigation of Transatlantic liners and other shipping in Plymouth Sound during fog, the Great Western Railway Company is considering the construction of a beam wireless station. Difficulties experienced in the past, and particularly the mishap to the liner "Paris" last April, when she struck the Eddystone Reef in a dense fog, are responsible for the proposal. The only stations of the kind already existing in the West are at Start Point and the Lizard. The Great Western Company contemplates erecting the proposed new directional wireless beacon at Penlee Point, at the western end of Plymouth Sound. The company owns the docks at Plymouth and is prepared to bear the cost of building and equipping the station, but the cost of maintaining it is a difficulty that is holding up the scheme. The company is stated to insist that after providing the station it should not be expected to bear an annual expenditure of from £600 to £1000. It is hoped that negotiations now in progress will settle the question of maintenance, but in the event of their failing to do so, the station may not be built.

Re-engined German Atlantic Liners.

ON Sunday last, the reconditioned and re-engined 33,000-ton North German Lloyd liner "Columbus" called at Southampton for passengers on her first voyage to New York. The funnels of the ship have been altered, and with her lengthened bridge and new scheme of colouring, she presents something of the distinctive lines we have come to associate with her larger and more powerful sister, the "Bremen." The "Columbus" has been fitted with new twin-screw high-pressure turbines, which, as regards the output of the individual units, are larger than those of the quadruple-screw liners "Bremen" and "Europa." New and larger boilers have also been installed for raising the increased amount of steam now required. Considerable improvements have been made in the passenger accommodation. Before taking up her regular Atlantic service with the "Bremen" and "Europa" in May next, the "Columbus" is to make a world cruise and will start from New York in January. The work of refitting the ship and installing the new machinery has occupied several months. Whereas the "Columbus" formerly required eight days to make the trip from Southampton to New York, she is now scheduled to reach America on the sixth day, and the voyage from New York to Germany is to be made in seven days. In the early spring of next year, four Hamburg-Amerika ships, the "Hamburg," "New York," "Albert Ballin" and "Deutschland," will be re-commissioned, each of which has been re-engined to obtain a higher operating speed.

Proposed Port Improvements.

A COMMITTEE representing the Chamber of Shipping, the Association of British Chambers of Commerce and the Federation of British Industries, has recently completed a report which deals with schemes of port development in Great Britain. It is suggested that while in principle the shipping industry is opposed to State aid to trade and industry, the undertaking, with Government assistance in order to relieve unemployment, of the schemes outlined in the report, would prove of advantage to trade. While the need of overseas shipping has, it is stated, largely been met by substantial improvements at the ports of London, Liverpool, Glasgow and Bristol, there are, nevertheless, numerous schemes which, with Government assistance, might be undertaken immediately, instead of being postponed for some years. The report contains a series of short descriptions of possible improvements at the ports of London, Middlesbrough, Glasgow, Leith, Newcastle-on-Tyne, Hull and Swansea. The question of the coasting trade of the country is dealt with at some length, and the value of our smaller coastal ports emphasised. It is suggested by the Committee that some of these small ports, many of which are no longer used, might with a comparatively small expenditure of money, be re-commissioned, and that if this were done, they would soon regain much of their former traffic. Some of the more desirable features for the berthing of small cargo liners and the loading and discharging of coal and other cargoes, are enumerated, and the suggestion is put forward that an expansion of coastal trade might be stimulated by the introduction of sea-going barges propelled by internal combustion engines. Such craft now trade from Holland to the Thames, and during recent years over one hundred of these barges have been added to the British Register. The improvement of such canals as are still used, would also, in the opinion of the Committee, react favourably on the trade of the country.

The Late Sir Henry Jackson.

THE death occurred on Saturday, December 14th, of Admiral Sir Henry Bradwardine Jackson, whose name has long been associated with the progress of wireless in the Fleet. In conjunction with Marconi, whom he met in 1906, he did much towards introducing wireless telephony in H.M. ships, and he was a familiar figure at meetings devoted to wireless subjects. During the first few weeks of the war, as Chief of the Naval War Staff, he was responsible together with Mr. Winston Churchill, as First Lord, and Prince Louis of Battenburg, as the First Sea Lord, for the naval dispositions covering the transport of the British Expeditionary Force to France, and the initial movements for the protection of British shipping. At the end of August, 1914, however, he was relieved by the late Admiral Sturdee. He was born on January 31st, 1855, and joined the Navy at the age of 13. On passing for Lieutenant, he went to the "Active," and served in that ship during the Zulu War of 1878-9. In 1902 he became Assistant Director of Torpedos, and three years later Controller of the Navy. He was promoted to Flag rank in October, 1906. For two years dating from October, 1908, he commanded the Sixth Cruiser Squadron. His knowledge of science and aeronautics led to his being appointed Admiralty representative at the International Conference on Aerial Navigation, held in Paris in 1910. In 1911-13 he was in command of the Royal Naval War College, and during that period he temporarily commended a battery squadron in the big naval manœuvres of July, 1912. His appointment as chief of the newly created Naval Staff, of which he was always a strong supporter, followed in February, 1913. He was nominated Commander-in-Chief in the Mediterranean and was to have proceeded there in August, 1914, but owing to the outbreak of the Great War he was retained on the War Staff. In May, 1915, he succeeded Lord Fisher as First Sea Lord and held that office until November, 1916.

Induction Furnaces.

No. I.

THE operation of induction furnaces is dependent upon the fact that when materials capable of conducting electricity are subject to an alternating magnetic field, eddy currents are induced in them, and cause the material to heat up and melt. The heating and melting of metals in this way is perhaps the nearest approach to the ideal method, because the heat is generated in the metal itself. Electric

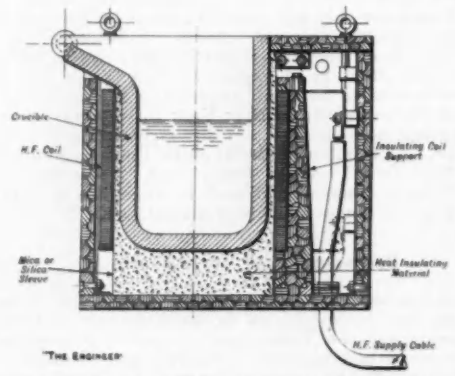


FIG. 1—SECTION THROUGH HIGH-FREQUENCY FURNACE

furnaces operating on this principle are of two kinds—standard frequency induction furnaces and those which employ high-frequency currents. While the former is limited in its application by metallurgical considerations as well as by problems of electrical design, the high-frequency furnace removes these limitations and gives a wider field to metallurgical research, and to the melting on a commercial scale of metals having high melting points. When it is desired rapidly to raise the temperature of small objects to high values, the advantages of this form of heating are very marked. It is possible, for example, to raise platinum from ordinary room temperature to 2000 deg. Cent. in a few minutes. The use of coreless induction furnaces affords a means of producing high quality steels at low cost. The great rapidity of melting and the violent mixing of alloys are claimed by the makers and users of induction furnaces to result in the production of steel having a greater homogeneity than that obtainable by other processes.

The construction of the Ajax-Northrup furnace—Fig. 1—is now pretty well known. Briefly, it consists of a body or box containing a helical water-cooled copper coil through which the high-frequency current is passed. Although this coil is only 2in. or 3in. from the molten metal, its temperature never exceeds 90 deg. Cent. Inside this coil is the crucible or a formed lining, packed externally with suitable sand. As the heat is generated within the metal itself the outside of the crucible is always cooler than the inner wall, and as the crucible is supported externally by the sand and is not heated above the temperature of the steel, wear and tear are minimised. On account of the electrical action the mixing is exceptionally good. Furnaces with an output of 1 ton per hour—Fig. 2—are now available, and there is no technical difficulty in producing them for larger capacity. Fig. 3 shows a 5-cwt. 150-kW Ajax-Northrup high-frequency furnace for steel and other alloys. Including all losses in motor generator and other equipment, the power consumption per ton when melting continuously is from 650 to 700 units. If the raw materials for melting are delivered on the furnace platform and labour is available for removing the ingots, a single furnace of 5-cwt. capacity will produce from 4 to 5 tons of ingots in twenty-four hours, with the assistance of only one man and a boy per shift. The following typical figures are from a Sheffield steel works, and are the result of seventy-two consecutive heats :—

Average weight of charge	5 cwt.
Total weight of topped ingots	343 cwt.
Total units consumed	13,881
Consumption in units per ton charged	770

Five cwt. of 18 per cent. tungsten steel can be melted in 60 minutes.

The cost of crucibles depends on the method of

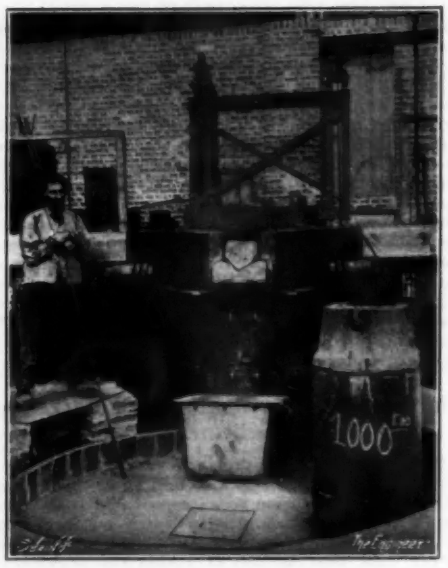


FIG. 2—1-TON FURNACE

lining the furnace. The life of a plumbago pot varies from twelve to twenty-two heats, when melting high-speed steel, and from thirty to thirty-five heats in the case of plain carbon steel. But the "EFCO" patented method of making crucibles within the furnace itself results in marked economy. The method consists of preparing a metallic or conductive former, the outside having the size and shape of the inside of the crucible required. Round this former a special dry powdered cement is poured and rammed, so that when heat is produced by induction in the former the crucible is formed by fritting the refractory cement, and the former may be melted and left in the first charge or withdrawn. In this way a siliceous, basic, or neutral lining, which is said to have a much longer life than an expensive plumbago crucible, can be made at a relatively small cost.

Low carbon stainless iron can be melted by induction without picking up carbon or impurities from furnace gases, and with practically no loss of chromium. In the manufacture of light steel castings, the process enables small heats to be rapidly melted. The steel can be poured directly into the moulds, and it can be kept hot during the pouring process. Thus, if very light castings are being made, it is unnecessary to pour at too high a temperature at the outset, in order to ensure that the last part of the charge will be sufficiently hot to run.

Although the steel industry is the most obvious field for high-frequency melting, the method may be adopted elsewhere. Furnaces are in use at several works for melting such material as pure nickel, cupro-nickel, nickel-chrome, nickel-iron, and nickel-silver. All these metals and alloys are said to be melted far more cheaply by the high-frequency process than by the crucible process, and for the reasons stated the

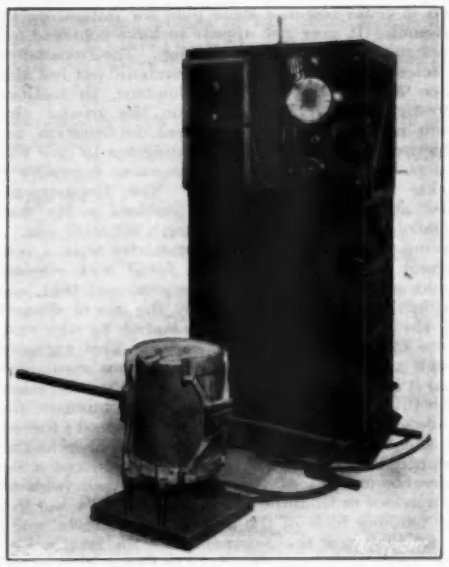


FIG. 5—STATIC CONVERTER AND FURNACE

quality is said to be better. There is obviously no risk of the introduction of carbon from electrodes as in the case of an arc furnace. Owing to the natural and intense mixing, copper and its alloys, such as copper-cadmium, copper-manganese, &c., can be advantageously melted. Much information on the uses to which induction furnaces can be put is to be found in Mr. D. F. Campbell's paper on "Recent Developments in Electric Furnaces," read before a meeting of the Institute of Metals last March.

For the operation of the smaller high-frequency furnaces, the Electric Furnace Company, Ltd., the makers of the Ajax-Northrup high-frequency furnace and the Ajax-Wyatt low-frequency furnace, supplies a static converter, which generates high-frequency currents by the charging and discharging of condensers, and which is capable of giving a wide range of frequencies. The frequency F is given by the formula

$$F = \frac{1}{2\pi\sqrt{LC}}$$

where L is the inductance of the coil in henries, C the capacity of the condensers in farads. As the capacity of the circuit is fixed, the change of frequency is obtained by altering the size of the furnace coil. The high-frequency current circuit in the equipment is separated from the low-frequency high-tension circuit by means of two banks of condensers. The high-frequency currents of the magnitude used with the

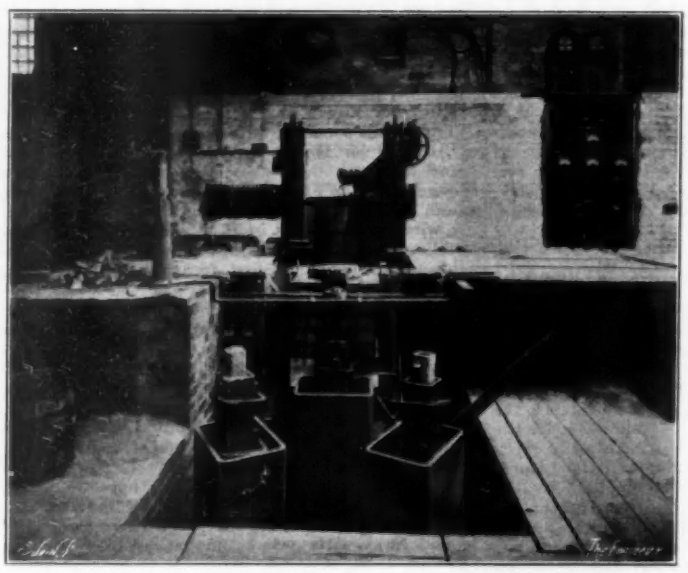


FIG. 3—150-kW AJAX-NORTHRUP HIGH-FREQUENCY FURNACE

FIG. 4—6-CWT AJAX-WYATT FURNACES

equipment cannot cause a dangerous shock and the furnace may therefore be used with perfect safety. The equipment which is shown in Fig. 5 consists of an oil-cooled transformer to step the voltage up to that required for charging the condensers, a bank of condensers, spark gap, safety gap, the main switch and control handle for regulating the power, and a wattmeter showing the input into the equipment. All the equipment, with the exception of the main switch control handle, wattmeter and fuses which are mounted on a slate panel fixed to the cage, are inside the cage. The converters are made for single, two, or three-phase working in sizes of 5, 15, and 40 kVA, and they may be connected to any standard low-tension alternating-current supply. The furnaces designed to work in conjunction with these condensers vary in diameter from 2in. to 10in. and consist of a water-cooled coil surrounding a tube of electrical

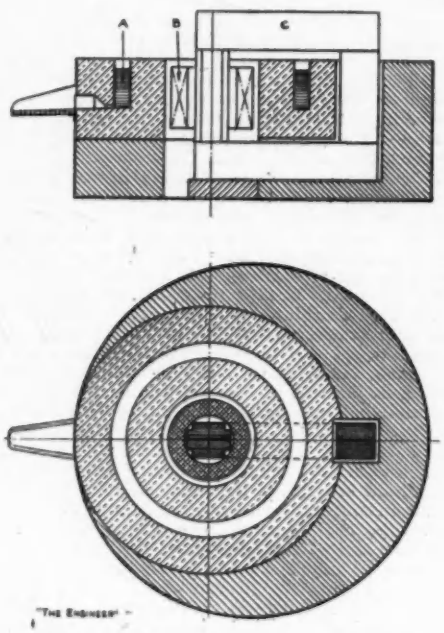


FIG. 6—SIMPLE RING TYPE OF FURNACE

insulating material. In this tube the crucible is placed and is surrounded by heat-insulating refractory material. If the material to be melted or heated is a conductor of electricity, the crucible may be made of non-conducting material, such as clay or magnesite, but if a non-conductor is to be heated or melted, a crucible made of conducting material, such as graphite, is used.

For the melting of brass for rolling mills and extrusion processes, the Ajax-Wyatt low frequency furnace is now widely used in the larger European and American works. Its usefulness has also been proved in the case of nickel brasses of various analyses; its suitability for melting other metals, such as cast iron, has also been demonstrated. The patented method of putting the lining in the manner described is also applicable to these furnaces.

Ajax-Wyatt furnaces of 600 lb., 1200 lb. and 2240 lb. capacity, absorbing 60 kW, 120 kW, and 240 kW respectively, have been built. Generally speaking, the two smaller sizes are to be recommended. In a French works very large induction furnaces are used for brass melting, scrap being charged and the metal poured at frequent intervals. The furnaces are used as metal mixers to overcome slight irregularities in composition of the scrap, but this system of working is now giving way to intermittent working in smaller units. In all countries the system of pouring the whole charge, with the exception of an amount necessary to maintain the secondary circuit, is generally adopted. The 600 lb. or 1200 lb. units are in this case preferred. The larger furnace has the advantage of a 10 per cent. reduction in the amount of electric current used for melting, and a substantial reduction in labour costs, especially when casting large ingots; but when casting small billets, generally used in England for the cold rolling of brass strip, the smaller 600 lb. unit is usually to be preferred. The casting of one charge, involving the pouring and feeding of a large number of small moulds, often takes from ten to twelve minutes, and if this time be doubled for a large furnace, the proportion of time lost is sufficient to offset the advantage in the reduction in power consumption and labour costs. Thus the arrangement of the shop and casting methods adopted should be the determining factor in choosing between units of 600 lb. and 1200 lb. capacity, and this will depend largely on whether hot or cold rolling is adopted, and consequently large or small billets are required. Two 6-cwt. Ajax-Wyatt furnaces are shown in Fig. 4.

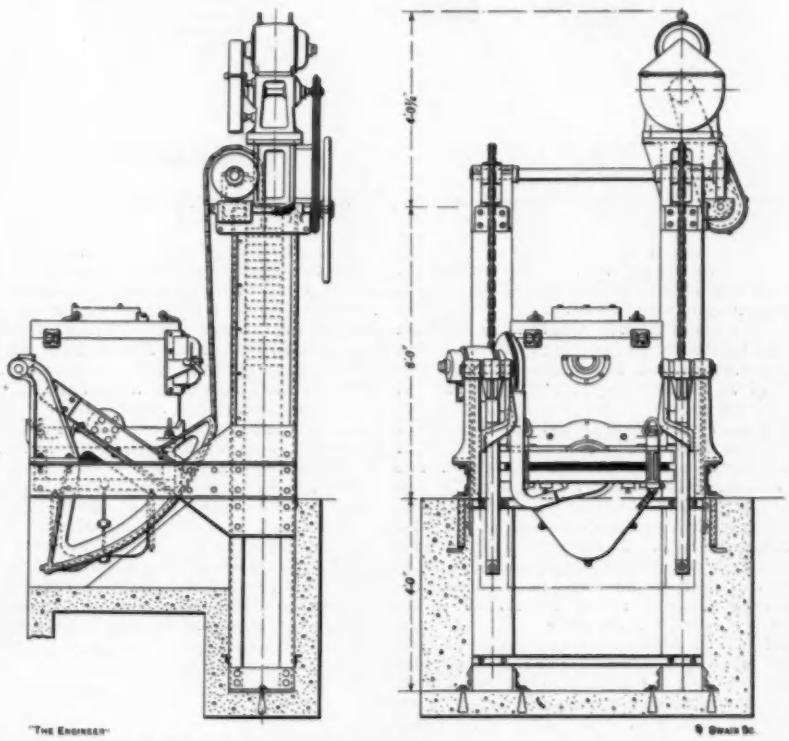
The induction furnace most commonly used is the Ajax-Wyatt type having a vertical secondary channel, but other furnaces have been built with horizontal submerged channels. Large furnaces of this type, having a 2-ton metal bath, using three-phase current, have been in use for some years in France, but, although the power consumption is about the same as that of the vertical channel furnaces, the power factor is only about 0·5, so that they are inadmissible on power supply circuits without heavy penalties or much capital expenditure for condensers or synchronous motors for improvement of power factor. These large horizontal furnaces have the same objection as the old induction furnaces used in the steel trade, which led to their abandonment in most cases. The vertical design lends itself to high power factor, as small distances between the secondary circuit and transformer core are essential to economical installation and operation, and this feature must be incorporated in all designs of induction furnace.

It may be of interest to consider here some of the steps in the development of the modern Ajax-Wyatt low-frequency furnace. In low-frequency furnaces of the simple ring secondary type the metal A—Fig. 6—is contained in a horizontal ring arranged concentrically with an iron core C composed of transformer iron which carries the transformer winding B. Whereas in a transformer the primary and secondary windings are close together, in the induction furnace there is a large space between them. This space is filled with refractory lining and the large leakage area for the magnetic field gives a poor power factor. The space varies greatly with the melting temperature of the metal and the size of the furnace, but under the most favourable circumstances it is comparatively large. Moreover, as the secondary channel has to take the complete charge, if its diameter is to remain within practical limits, its cross section must be large, this again introducing conditions unfavourable from the point of view of maintaining a high power factor. Many schemes have been devised with a view to reducing the magnetic leakage, and to a certain extent the power factor has been improved.

In starting the furnace it is necessary to pour sufficient molten metal into the secondary channel to form an electrical circuit with a cross section sufficiently large to deal with the current required to heat the charge, and after this metal has attained the desired temperature cold scrap is added in small quantities until the complete charge is molten. After pouring the metal a sufficient quantity is left in the channel to form the necessary circuit for the next charge. With the open type of furnace the cross section of the bath varies according to the weight of metal charged; its resistance will also vary, so that, with constant voltage, the current flowing in the channel will be smaller at the commencement than it will be after the complete charge is molten. The power factor varies considerably according to the state of the charge of the furnace. The rate of heating also varies, and although the charge may have been doubled, the kilowatts may only increase by about 20 per cent. But if voltage regulationbe adopted, the power may be increased to a certain extent depending on the current density of the bath. Owing to the phenomennon known as "pinch" effect, there are well-defined limits beyond which the current cannot be increased. The maximum electrical power of the furnace cannot therefore be used throughout the whole of the charge unless a proportion of the molten metal be left in the bath, and consequently the load factor will be low. With large furnaces of the simple ring secondary type it is necessary to reduce the frequency, and the usual practice is to install a motor generator so that three-phase current may be taken from the line and single-phase current of the required frequency may be delivered to the furnace. As the motor is of the synchronous type, it may be employed to advance the power factor. The Rochling-Rodenhauser furnace is built on special lines and makes use of polyphase current and may be connected to a standard supply without giving rise to an unduly low power factor.

Dr. Carl Hering observed that when current was passing through a molten metal conductor contained in an open trough, deep depressions of the metal took place when the current reached a certain density. This effect is known as the "pinch" effect and has a considerable bearing on the design of modern induction furnaces. It is well known that parallel conductors carrying current flowing in the same direction attract each other, and the molten metal in the secondary of an induction furnace may be regarded as an indefinite number of current paths. Each of these paths will tend to move towards the axis of the conductor, and in the event of the current being raised beyond a certain point the force will be great enough momentarily to interrupt the circuit. Hence there are limits to the current density allowable in the molten secondary. The force due to what is known as "motor" effect also has a very important bearing on induction furnace design, especially in the case of the Ajax-Wyatt furnaces for melting non-ferrous metals.

Most of the earlier furnaces were developed for the melting of high-resistance metals, such as steel, &c., and very little attention was paid in the early days to the melting of non-ferrous metals and alloys, such as copper and brass. The poor results obtained with the open channel type of furnace when attempts were made to melt non-ferrous metals and alloys were principally due to the low power factor and "pinch" effect. Owing to the higher resistance of steel the current density required to melt at a practical rate may be adjusted so that the "pinch" effect does not break the secondary, but in the case of low-resistance metals the current density for practical melting in a horizontal ring furnace may be so great that the "pinch" effect will break the molten metal circuit. The power factor of the secondary channel will also be lower than that of steel, and the resistance may be so variable that the operation of the furnace will become impracticable. It is, however, in the melting of non-ferrous metals and alloys of the copper-zinc



FIGS. 7 AND 8—SIDE AND FRONT VIEWS OF AJAX-WYATT FURNACE

type that the characteristics of the induction furnace are much more favourable than those of the arc furnace. Unless very pure and expensive scrap is used in the melting of steel and ferrous alloys, it is necessary to refine the molten metal, and it is important that the slag should be hotter than the molten metal so that the chemical actions for the removal of impurities may take place. Whilst in the arc furnace the required conditions exist, owing to the fact that slag is a poor conductor of electricity, it is extremely difficult with an induction furnace to generate sufficient heat in it to hold it at the required temperature. On the other hand, when melting copper-zinc alloys, owing to the low volatilisation point of zinc, it is important that no part of the bath shall be heated to an excessive temperature. In the arc furnace this condition is not easily obtained, but in the case of

induction heating the temperature can readily be kept within the desired limits.

In the case of the important commercial alloys, namely, those containing from 30 to 40 per cent. of zinc, very little difference exists between the temperature required for successful pouring and that at which the zinc in these alloys volatilises, and therefore the control of heat and the temperature at which the heat is applied to the metal are of the utmost importance. Owing to the low power factor, the varying input and "pinch" effect, for those alloys, the open horizontal channel induction furnace is limited in its application, whilst the arc furnace is unsuitable on account of its heavy zinc losses. In order to overcome the various difficulties C. P. Schneider devised the original closed-channel type of furnace in which the ends of the channel terminate in a bath of molten metal placed above them, which maintains pressure in the channel. As, however, the circulation of the metal in the secondary channel was insufficient to prevent the metal being overheated, the furnace proved impracticable. James Wyatt noticed, however, whilst carrying out experiments, that a peculiar effect was noticeable in the molten metal, and investigations were undertaken with a view to finding the cause. From the information gained the closed channel furnace known as the Ajax-Wyatt furnace was developed. It was found that on passing current through a molten metal conductor contained in a rigid channel, a strong repelling effect took place whenever a well-defined angle was formed, this action tending to break up the metal against the side of the channel. It became clear that, whenever a sharply defined angle was formed, a magnetic action took place on the molten metal, which tended to eject molten metal from the channel. It was therefore decided that the corners at the point where the ends of the channel meet the bath must be rounded in order to obtain the maximum rate of flow.

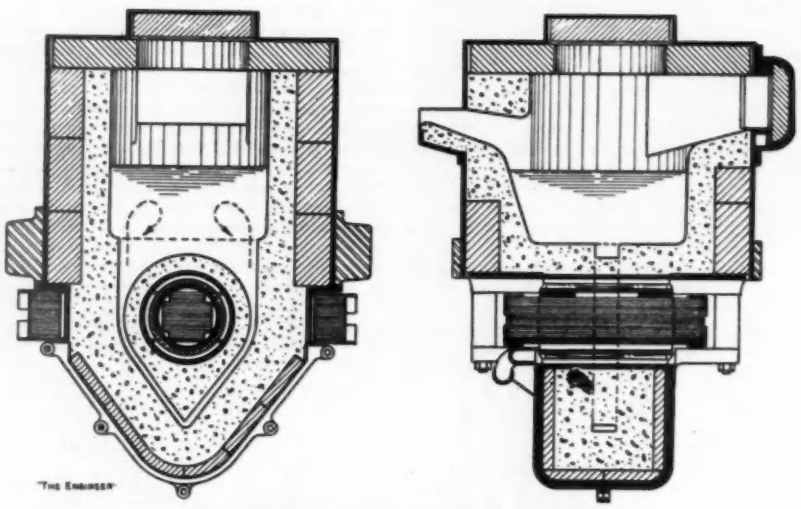


FIG. 9—SECTIONS OF 75-kVA AJAX-WYATT FURNACE

The present type of Ajax-Wyatt furnace has been developed to utilise the forces due to the pinch and motor effects to the best advantage. A side and front view of 75 kVA single-phase 50-cycle 440-volt furnace having a normal capacity of 600 lb. per hour is shown in Figs. 7 and 8 respectively. Sections of the same furnace are shown in Fig. 9, from which it will be noted that the secondary portion consists of two channels or arms which form an angle of 70 deg. Above these arms is the bath of molten metal, and the upper part of each arm is rounded off at the point where it meets the bath. The resistance of the lower or V-shaped part of the secondary channel is about 80 per cent. of that of the whole furnace, and the V-shaped part contains about 100 lb. of metal. In practice it is found that, when the channels form an angle of 75 deg. in relation to each other, a good metal flow is secured. Where the channels widen out where they meet the bath, the current density is much less than further down the channel, and there is an increased circulation of the metal owing to the pinch effect.

The critical current density at which the force known as the "pinch" effect will tend to reduce a conductor to half its cross section is given by $C D = 895 \sqrt{G/H}$, in which C D is the current density in ampères per square inch, G the specific gravity of the molten metal, and H the depth of metal. As the current in the channel—shown in Fig. 9—is many times greater than that given by the above formula, if it were not for the head maintained in the channel by the bath of molten metal above it, the "pinch" effect would break the circuit. The circulation of the metal in the furnace is attributable to various effects. As the metal becomes heated in the channels and is forced to their outlet sides, its place is taken by the colder metal flowing in, this flow being due to heat convection currents or the Joule effect. The arrows in Fig. 9 show the direction of the circulation. To insure a homogeneous alloy throughout the charge it is necessary when making copper zinc alloys for the metal to be well stirred. Where a pit fire furnace is in use the stirring is done by the melter who uses an iron bar for the purpose just before the metal is ready to be poured. With the type of furnace under consideration, however, the stirring is caused by the above-mentioned effects, and is automatic and continuous.

When a single-phase transformer is used to step down the voltage to that required for the furnaces—provided this voltage is about 440—a tapping is generally taken out at the mid-point of the secondary winding and earthed as a precautionary measure against dangerous shocks. The secondary winding is also tapped so that different voltages may be applied to the furnace. When the furnace is connected to a 440-volt supply with unearthed neutral, an earth case is fitted over the primary winding of the transformer. A 1 horse-power motor serves for tilting the furnace, whilst a ½ horse-power motor is used for driving the transformer cooling fan. As the furnace transformer has to be dismantled each time the furnace is lined the laminations are designed to facilitate the work. A small fan blows air over the centre leg of the transformer whilst it is in operation.

The furnace is lined with a refractory cement, which is rammed into the furnace by means of pneumatic hammers. The bottom castings are placed on a stand and are lined with asbestos sheet and heat-insulating bricks. The wood former which constitutes the secondary channels is placed in position, and the cement is rammed round it, this operation being continued until the cement is at a sufficient height to place the former in position, which forms the hole to take the centre leg of the transformer. The bottom brass ring is also placed in position, and the lining is rammed up to the point where the furnace shell is bolted on. The first row of heat-insulating bricks is then placed inside the shell, and the ramming is continued up to the point at which the crucible form and spout forms are placed in position. Ramming is then continued until the top of the furnace is reached. The various formers, with the exception of the channel formers, are then removed, the furnace transformer is assembled, and the furnace is placed in its cradle. The channel former is then burnt out. Next the furnace is dried for a period of three or four days, after which about 200 lb. of molten metal is poured into it, and the current is switched on. Once the furnace has been started, it may be charged with swarf, ingots or scrap metal in any form, and when the furnace has been completely charged and the whole of the metal has reached its correct pouring temperature, the needles of the instrument begin to oscillate, owing to the varying conductivity of the channel.

(To be continued.)

Management and Cost Accountancy

By G. W. TRIPP, F.C.G.I., M.I. Mech. E., A.M. Inst. C.E.

IN a large number of engineering works the cost accountant is looked upon askance as a sort of pariah, to be tolerated at best, and to be ridiculed or ignored by the management as opportunity arises. In many cases it is largely his own fault, in that he forgets that his calling is a comparatively new one, and very productive of suspicion if viewed in a partisan spirit, while by his actions he often fosters the hostility that already has carelessly been engendered. He has been likened somewhat ungenerously to the fly on the axle of the chariot of the Roman warrior, which boasted about the dust it was raising, but like so many extravagant comparisons an element of truth lies behind it. Too frequently he regards his vocation as the end in itself rather than the means to that end. Nowadays, when it is decided to reorganise an engineering undertaking, one of the first steps is normally to appoint a cost accountant. When a marked improvement has been evidenced, this individual has been prone to claim the credit and thereafter assume the *rôle* of dictator, proceeding to instruct the management as to the right course of action.

From the outset, it must be clearly enunciated that the cost accountant is the servant of the management, his functions being to present facts in the manner that is required of him. In gathering together the requisite information, a shrewd man is admittedly often able to diagnose trouble, but it is not his business to devise means to eradicate that trouble, although the wise manager will not be averse from receiving suggestions. The function of each unit in an organisation should be clearly defined and observed if the best results are to be obtained, and it cannot be too emphatically stated that management is not the business of the cost accountant. But, on the other hand, the manager must not expect the impossible, such as demanding certain information as to the detailed cost of work when already half completed, and about which he had previously stated that all he was likely to need would be the total cost of the job. The greater the degree of refinement required, the more costly will be the operation of gathering the necessary statistics. To take a concrete case:—An engine, consisting of frame, cylinders, pistons, piston-rods, crank, crank shafts, gear, &c., can be costed as a complete engine, in which case all the different operations on the component units will normally be booked to one works number, whereas if the cost of the frame and other components is required individually, each must have its own particular number or sub-number to which the charges will be carried. If, after the cranks and crank shafts have been machined, and erection has begun, the manager suddenly realises that with orders for spares in view it would be advantageous to have the actual cost of crank, crank shafts and other units separately, and asks the cost accountant to give these to him, he must not be surprised if he meet with a refusal, polite or the reverse, according to the idiosyncrasy of the individual. This instance is cited merely to show the necessity for genuine co-operation between two important branches of the organisation.

To ensure this harmony the manager must know something of the aims of the man who professes to be his ally, and whose vocation is not a difficult one to understand, provided the root principles are mastered.

To state that the primary object of costing is to determine the actual cost of each article, manufacturing operation, or even process, may be regarded as a statement of the obvious, but it is desirable to make it before saying that the chief problem lies in the method of determination. The point of view affects the answer as to what is the actual cost of an article. The foreman is prone to regard it as a summation of the value of the materials used and the wages of the workmen employed, but this should be spoken of as the "prime cost." He has to be educated to realise what is involved in the term "on-cost," and, having grasped this, his training must be carried a stage further, so that he himself may appreciate the extent to which he personally can have an influence on these charges. While, broadly speaking, this total of material, wages and on-cost represents the actual cost to the works manager, it is advisable always to allude to it as "works cost." In most organisations considerable expenditure is incurred in the marketing of the finished article, and this leads to a substantial sum being necessary to cover these selling expenses. The combination of works cost and selling expenses produces the "total cost," so termed because it represents the real cost to a firm of producing and marketing the article. There is, however, one stage further before the "selling price" is determined, but this is merely the total cost plus a prearranged percentage for profit.

It thus becomes the business of the cost accountant so to abstract and present these different costs that, while always representing as true a picture as is possible, they may also yield the maximum usefulness to each section of the management.

It will readily be conceded that if the cost of the material used in satisfaction of an order is to be correct, there must be an efficient method of stores accounting and control, otherwise it will be impossible to ensure a reliable record of stores incoming and outgoing. The organisation of a stores department is outside the scope of the present article, but without a good system cost accountancy will be seriously handicapped. In addition to materials purchased in the raw state, it is often convenient to treat castings and forgings as materials, the labour and on-cost involved in their manufacture being incorporated in the cost of the casting or forging. This enables products of the primary trades, whether purchased from outside, or manufactured locally, to bear the same relation to the other items of cost.

It has sometimes been argued that because the reliability of the figures obtained as representing the cost of materials is so dependent on the efficiency of the stores department, that this important branch of the organisation should be under the control of the cost accountant, but we cannot subscribe to this view, although we would again emphasise that there must be real co-operation to ensure the best results.

If a certain quantity of material is required in satisfaction of a specific works order, and more than the requisite amount is drawn, possibly quite legiti-

mately, as, for instance, if a whole bar of steel is drawn because there is no saw in the store house, but only part is actually needed, unless the residue is returned to store in the manner prescribed in the scheme of things, the works order will naturally have the value of the complete bar charged against it. Should the surplus be returned at a later date, after the cost has been abstracted, it is obvious that considerable trouble will subsequently be caused by making the appropriate adjustments. The factory people cannot have it both ways; they cannot put by a certain amount of material against a "rainy day" and at the same time not see the cost of material against the works order higher than it ought to be. By prompt attention to detail, seeing that the stores are drawn in the right amount, charged to the appropriate order, and that due credit is allowed for the return of surplus, not only is the works management helping the cost accountant, but it is also helping itself.

If the factory worker is remunerated on some system of payment by results, the piecework card or the time allowance converted to money gives a very good indication of the cost of direct wages. A definite check on expenditure is available assuming there is a rigid ruling that no cards, other than those for which allowance has been made, can be issued without authority. An application of the system has already been explained in a former article on "Rate-fixing."* Work done day work must also have its appropriate card, and payment will only be made in respect of work that has been authorised by the issue of a card.

It is when we come to the question of "on-cost" that the cost accountant can be most useful, but even in this sphere he must rely a great deal on the good-will of the management. A good definition of on-cost is not easy, but the one arrived at in a negative sort of way is probably the simplest, *i.e.*, that on-cost includes everything that is not classified as either direct material or direct wages. It is usual and useful to divide it into three classes:—(1) General, (2) factory or departmental, and (3) workshop. As indicated by its name, general on-cost comprises those charges which have to be spread over all departments, and includes such items as rates and taxes, cost of buildings and rent, the expenses due to the main office, and general administration, &c. In the second category—factory or departmental—will be found those charges which can be attributed to an individual department, but cannot conveniently be charged to the workshop itself, and in this group may be cited the salaries of the management staff, service charges, such as light, power, stores, &c. In the third section, the workshop on-cost will be the pay of shop foremen, assistants, technical and clerical, shop labour, cleaning, &c., machinery, and all charges that are obviously made in respect of the workshop alone.

Having determined into which category each item of oncost is intended to fall, the business of the cost accountant is to ensure the correct collection of these charges, so that production will pay for all the services rendered. A number of definite methods have been evolved, among which may be mentioned the following:—

(1) The levying of a predetermined percentage, either (*a*) on the direct wages or (*b*) on the prime cost.
(2) Assessing a rate per hour of direct labour.
(3) Using a departmental rate.
(4) The machine-hour rate method.

The first of these has the merit of simplicity, but little else, for it is prone to be very inexact, and cannot be recommended except in a few special cases. The known total on-cost for a preceding period and the known direct wages are taken, and the percentage of oncost to direct labour is thereafter used for recovering the cost of the next year or period. If, for the sake of example, the on-cost charges had amounted to £36,000, and the direct wages for the same period had been £40,000, the on-cost rate would be 90 per cent. The works cost of a job would thus be the summation of the direct material cost, the direct wages cost, and 90 per cent. of the direct wages (to cover on-cost). The fallacy of this method will be readily appreciated when it is pointed out that two jobs which happened to have the same value of material and the same amount of direct wages, would both be treated as having cost the same, although one required heavy and expensive machinery in its production, as well as the use of cranes, &c., whereas the other merely involved fitting and little else!

It was to avoid such anomalies that the departmental rate was evolved, this being different for various departments or sections to meet the conditions obtaining in each department. The rate is arrived at either by the percentage on direct wages or by the rate per hour method, but an appropriate distribution is made, so that the rate assessed for each section is as equitable as possible with due regard to the incidence of on-cost charges.

But it is the machine-hour rate that not only presents the truest picture, but at the same time gives the most help to the management and workshop administration generally. The underlying principle of this system is that every item of on-cost is carried to the machine, and for this purpose the word "machine" is used in its widest application, and would include the tank for electro-plating, as well as the fitter's vice.

The manager's salary will be distributed to every machine in his department, just as that of the foreman will be to all the machines in the particular shop which he rules. The cost of the oil used to lubricate the machine will also have to be met by the production of the machine, in common with all the stores for shop use; indeed, everything in the total cost of work, after the direct material and the direct wages have been eliminated.

The simplest cases will be those in which the charge can legitimately be divided equally among all the machines in a shop; all of these are usually collected and treated as one item from the point of view of assessing a rate. Thus, it may be agreed that the pay of the foreman, his assistants, whether technical or clerical, the cost of labouring and cleaning, and other charges, can be shared equally. Assuming the total bill for these items amounts to £1000 per annum, if the number of working weeks, after a holiday period has been deducted, is fifty, and there are sixty machines in the shop, and the average number of hours worked, after allowance has been made for stoppages, slackness, &c., has been made, is forty per week, then the rate applied to recover these charges will be

$$\frac{1000 \times 240}{60 \times 50 \times 40} \text{ pence per hour.}$$

This means that for every hour any machine in the shop is worked, 0·5d. must be added to defray that part of the on-cost which is represented by staff, labour, &c. In the absence of records, the number of hours that each machine works during the year must be estimated by the foreman and endorsed by the manager, preferably in consultation with the cost accountant.

When charges vary, the basis on which their allocation is determined is most important, and here once more the management can be of very great assistance. From experience it has been generally found that the cost of buildings can best be distributed on an *area* basis; and the departmental charge for buildings will be that fraction of the whole which is represented by the area covered by buildings in that one department, divided by the area occupied by all the buildings of the whole factory. In the same way the amount chargeable to a shop will be that fraction of the departmental charge represented by the area of the particular shop divided by the departmental area. Finally, to bring it one stage lower and to carry it to the machine, the area of floor space occupied by any machine, divided by the area of the shop floor, will yield the fraction used to arrive at the hourly rate to be applied to that machine.

In considering the important question of depreciation, it is felt that no one factor can be used with a reasonable degree of accuracy; although the initial cost of the machine will have an important bearing on the amount to be recovered with a view to ultimate replacement, the estimated life of the machine must also receive due consideration—yet another case in which the expert knowledge of the manager is invaluable. A very wise proceeding is to maintain depreciation charts for similar groups of machines, after agreement has been reached. The annual cost thus reached in pence, divided by the estimated working hours of the machine for the year, will give the fraction in pence as the hourly rate to be applied for depreciation.

The cost of maintenance is not dependent upon floor space, life, or initial cost; indeed, a cheap machine may often incur a higher repair bill than a very expensive one. In the absence of records of maintenance costs, the management is usually asked to divide the amount normally spent under this heading among the different units arbitrarily in the light of practical experience. After a period of six months, it will be evident whether the estimate was a fair one or not, and in the latter case revision can be made as a result of acquired experience, until after one or two revisions all concerned will probably be satisfied that the rate used is now as reasonably near the true state of affairs as can be expected.

The cost of the power used to drive the machine can be based on a factor determined with reference to the width of driving belt, and the normal running speed, but it is often found that the makers of machine tools state the horse-power required to drive, and though they may be unduly optimistic, it is probable that all makers err in the same direction, and the figures so obtained may legitimately be utilised.

All items of on-cost having been taken one by one, and reduced by experience, actual observation, and enlightened common sense, to a series of rates per hour, they are now summated, and the total gives a rate per hour which, when applied to the one machine for every hour it works, should account for all the on-cost for the whole organisation that is rightly chargeable to that one machine.

If all the machines in the factory are thus treated the total on-cost should be exactly absorbed, but as will readily be conceded, this is a counsel of perfection, and adjustments have to be made from time to time. If it is found that there has been an over-absorption, the hourly rate will be reduced to such an extent as it is estimated would yield the correct amount, while under-absorption will necessitate raising the rate.

As a number of items of on-cost are practically constant, an increase in the volume of work in the factory, involving as it does the machines running for a greater number of hours, will reduce the hourly rate of on-cost, and thereby the final cost of the product, a very important consideration for the estimator.

From what has already been said, it will be apparent that the management can greatly assist the cost accountant in arriving at reasonably reliable on-cost rates, but the question may arise as to the extent of the benefit likely to be derived by the management in return.

In the first case, the manager will soon realise that a high on-cost rate does not necessarily involve an expensive completed product. There may be many items which he knows he could charge directly to the shop production, but in order to keep his eye on the incidence of expenditure, he will prefer to treat as on-cost. He might, for example, decide that the cost of trucking half-finished articles from one part of the works to another could be conveniently charged to the manufacturing order, instead of to on-cost, but a moment's reflection will show how readily this charge would be "lost" if merged with the many manufacturing ones. The cost accountant should be required to produce period by period an on-cost statement showing the amount charged to each individual item for each shop. It is only by these means foremen and others realise how much money is going in different directions. When a foreman peruses his monthly statement and notices the heavy bill for "trucking"—to take one item—he may consider it excessive, and after examining it in detail he will be tempted to endeavour to improve methods and do all in his power to reduce the cost. The management will be well advised to see that only those items over which the shop administration has control, whole or partial, are set out in detail on the workshop on-cost statement. In addition, it is often the practice to give a short summary of the charges due to both general and departmental on-cost, in order that everyone who wishes to know may be informed as to the full incidence of the on-cost. An intelligent study of these statements by the officials most concerned has led to the effecting of many economies, and has also inspired numerous modifications and improvements, so that really substantial reductions in the total on-cost have been attained. In a way, it may be averred that the trouble has been diagnosed by the costing department, but the remedy has been prescribed and applied by the management. It is of incalculable value to be in a position to know exactly where the money is going.

A system of detailed costing is a great boon to the estimating department, placing at its disposal the actual cost of all work, and enabling estimating to be done in such a way that the actual cost will have a reasonable chance of proving to be somewhere near that estimated. For example, if it is arranged for work to be machined on a definite machine, after the hours required had been estimated, the appropriate hourly on-cost rate will be applied in the full knowledge that this is the rate which will be used if an order materialises, and eventually the job goes into the factory.

A comparison of the actual cost with the estimate in detail often reveals to the estimator any omissions of his, and it is also extremely useful to the management in bringing to light any wastefulness during manufacture, spoiled work, &c.

In conclusion, it must be emphasised that real harmony between the management and the costing department is vital, and it is suggested that this can best be obtained by every step being taken only after a conference between all concerned; while no innovation should be introduced until after it has been fully explained and understood, even down to the humblest bookkeeper. Along this line of intelligent co-operation success will be assured.

* THE ENGINEER, March 2nd, 1928.

Mitsubishi Shipbuilding and Engineering Company, Ltd.

THE following description of the Mitsubishi Zosen Kabushiki Kaisha has been sent to us by the company in connection with the recent Engineering Conferences.

ORIGIN AND GROWTH.

The origin of the company dates as far back as the Ansei era—that is, about seventy-four years ago—when a small and insignificant shipyard was founded at Nagasaki by the Tokugawa Shogunate, which, on the Restoration in 1871, was handed over to the Industrial Department of the Imperial Government. In 1884 the Government, with a view to encourage the development of shipbuilding in the country, and believing that this object could best be attained by private enterprise, decided to dispose of all the shipbuilding plants then under Government control to private interests, when the Nagasaki Zosen Kyoku, as this shipyard was then known, was leased to the Mitsubishi.

A few years later the shipyard was entirely transferred to, and came under the sole management of, the Mitsubishi, and immediately thereupon followed a big programme of expansion. Under the new man-

agement the business progressed so rapidly that, notwithstanding the continuous extension of the yard, which had been completely reformed and brought up to the highest state of efficiency, the company, in order to meet the heavy demands on its works and for further developing the industry, laid down a great shipbuilding and engineering plant at Kobe, and operations were commenced there in August, 1905. In December, 1914, the Hikoshima Works, in the Shimonoseki Straits, was added, thus assuring to the Mitsubishi a position in shipbuilding and engineering circles second to none in the Far East.

To cope adequately with the enormous growth of the undertaking, which was managed by the Shipbuilding and Engineering Department of the Mitsubishi Goshi Kaisha, a separate limited company with a capital of Yen 50,000,000 was registered in November, 1917, as the Mitsubishi Zosen Kabushiki Kaisha —the Mitsubishi Shipbuilding and Engineering Company, Ltd.—which took over all the shipbuilding and engineering activities of the Mitsubishi.

It will thus be seen that the company is one of the pioneer establishments in the Far East. It has played a most important part in the development of the shipbuilding and engineering industries of the Empire, being a principal contractor to the Imperial Japanese Navy, the Imperial Government Railways and the leading steamship companies, such as the Nippon Yusen Kaisha, the Osaka Shosen Kaisha, the Toyo Kisen Kaisha and others, and it has long been regarded rather as a national institution than an individual enterprise. Its head office, conforming to the usual Mitsubishi practice, is in Tokyo.

Nagasaki Works.

These works occupy a land area of 156 acres, with a water frontage about two miles in length along the western shore of Nagasaki, which is the chief south-western city of the Empire and possesses one of the finest harbours in the world. The works consist of two main plants, the Tategami Shipyard and the Akunoura Machinery Works, with ancillary saw mills and an electric steel works in the suburbs of the city.

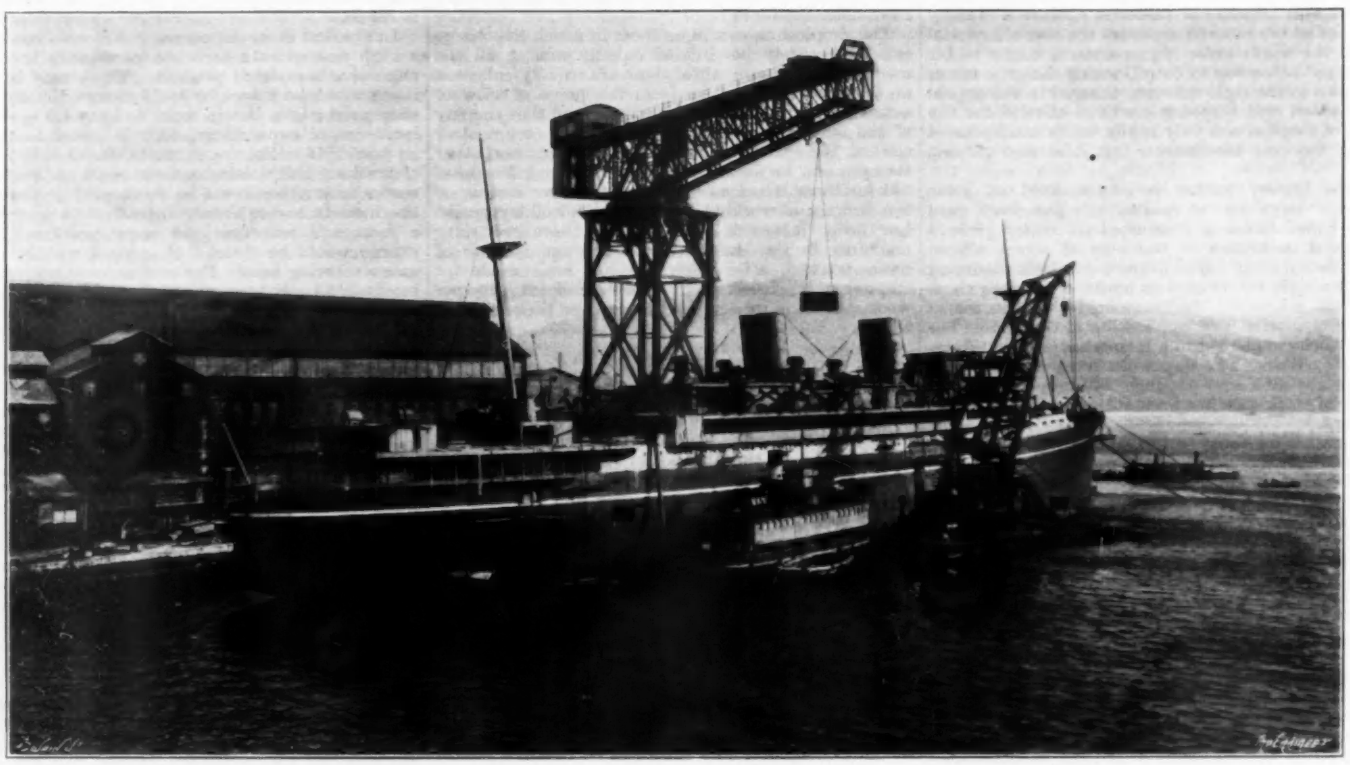
The Machinery Works includes fitters', machine, boiler, foundry, forge, smiths' and tool shops; also for the outside work section fitting-out shop, electric works, coppersmiths' and rigging shops, power-house and cranemen's house, &c., numbering forty-three buildings in all. A hammer head crane 178ft. in height, with a span of 54ft. and a lifting capacity of 150 tons, stands on the jetty.

The Shipyard has six concrete building berths, the dimensions of which are:—No. 1, 806ft. long and 64ft. wide; No. 2, 605ft. 3in. long and 65ft. 6in. wide; No. 3, 602ft. 3in. long and 34ft. wide; No. 4, 540ft. long and 32ft. wide; No. 5, 510ft. long and 28ft. wide; No. 6, 418ft. long and 28ft. wide.

No. 1 berth is equipped with a gantry 1061ft. long and 116ft. wide, while the other berths are provided with two revolving tower cranes and sixteen jigger posts. Ironworkers' and woodworkers' shops, tool, power and dockmen's houses, &c., total thirty-four buildings.

The Saw Mills and Timber Yard cover a total area of 16 acres. There are two three-storied buildings with motor room, working floors and filing rooms. The mill is equipped with a log hauler of the inclined type and three-lined live rollers of a total length of 493ft., and has a maximum annual capacity of 1,500,000 cubic feet of original timber.

The Art Metal Shop, which until some years ago confined its activities solely to the manufacture of furniture and fittings for warships and merchant vessels, has, in consequence of the heavy demand for this class of product, been greatly enlarged and the scope extended to meet the market needs in every line.



THE AKUNOURA MACHINERY WORKS OF THE MITSUBISHI SHIPBUILDING AND ENGINEERING COMPANY

Equipments and Docking Facilities.

Experimental Tank.—The company is justly proud of having an experimental tank at Nagasaki Works. As is well known, very few private shipyards in the world can boast of possessing this equipment. The tank was completed in 1908 and has proved of inestimable value.

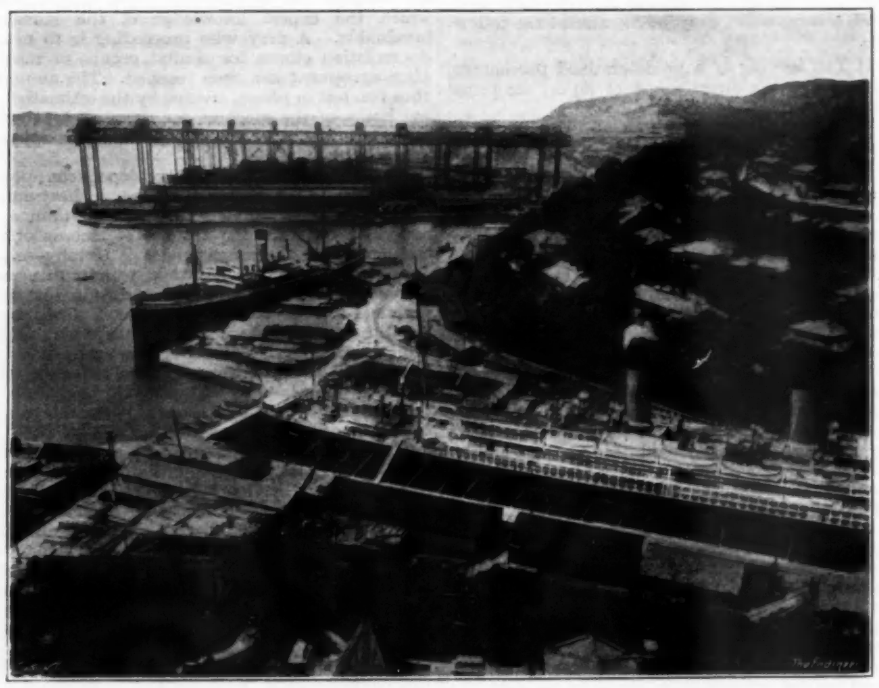
Laboratory.—The works has a laboratory, where testing and examination of all kinds of materials to be used in the works are carried out. Chemical and physical researches and experiments are also continually in progress. The equipment of this laboratory is complete in every respect, and is on such a large scale as cannot be found in any other works in Japan.

Docks.—The three docks here are constructed of stone, No. 1 having a length on keel blocks of 513ft.; No. 2, 350ft.; and No. 3, 714ft. The last one is capable of taking vessels of over 20,000 gross tons.

Power-house.—At the central power station in the works there are installed generating sets of various descriptions, which, producing 4000 kW of electricity, supply, together with 4800 kW procured from outside, power for running the 955 motors aggregating a horse-power of 22,500.

Principal Construction and Manufacture.

Shipbuilding.—The table given below is compiled up to the end of August, 1929. It shows the number of vessels built and equipped at this shipyard alone, and illustrates what has been accomplished since the Mitsubishi entered upon this enterprise:—



THE TATEGAMI SHIPYARD

Merchant Vessels.

1,000 gross tons and under 5,000 gross tons ..	40
5,000 ,, ,, 10,000 ,, ...	61
10,000 ,, and over	11
Total vessels	112

Warships.	
Under 1,000 tons displacement	13
1,000 tons and under 10,000 tons displacement	20
20,000 tons and over	3
Total vessels	36

Machinery Production.—The manufacture of all sorts of machinery for land and marine purposes is a necessary adjunct to the shipbuilding operations. Since the works commenced the manufacture of steam turbines in 1908, a total of 150 marine units of over 2,000,000 H.P. and 160 land units of over 300,000 kW have been produced. It is worthy of note that amongst all the turbine manufacturing plants in Japan, this works alone is capable of satisfying the increasing demand for big capacity units. Some of the large power turbines constructed and now on order are as follows :—

Completed and Delivered to Clients.

One, 12,500 kW	For the Fushun Colliery, of the South Manchurian Railway Co.
One, 25,000 kW	For the Imperial Steel Works, Yawata
One, 25,000 kW	For the Imperial Government Railways

Under Construction.

One, 25,000 kW	For the Imperial Government Railways
One, 25,000 kW	For the Fushun Colliery, of the South Manchurian Railway Co.

Kobe Works.

This shipyard and engine works is situated at the western end of Kobe Harbour, and covers an area of 120 acres with a water frontage of 2 miles, having two long breakwaters which form a basin of 24 acres. It has foundry, smiths', carpenters', boiler, machine, and pattern shops, &c., totalling fifty-eight, as well as a testing house and a laboratory. A large internal combustion engine works forms an important unit of this establishment. There are four concrete building berths in the shipyard, three of which are each 405ft. long and 30ft. wide, while No. 4 is 350ft. in length and 64ft. wide, and three floating docks, particulars of which are as under :—

	Tons.	Length.	Width at the entrance.	Depth.
		Ft. in.	Ft. in.	Ft.
No. 1	7,000	412 8	59 0	20
No. 2	12,000	532 0	69 0	24
No. 3	16,000	410 0	102 10	28

Of these docks, No. 2 was constructed by the works, and is the largest ever built in Japan. All these docks are fitted with special appliances for the expeditious docking of vessels.

Repair Work.—One of the most important branches of industry conducted at this shipyard and engine works is the repair of vessels. Being conveniently situated in the largest port of the Empire, and possessing all facilities for carrying out such work expeditiously, the company's activities in this line are on a scale unequalled in the Far East.

Work Carried Out During 1928.

Vessels repaired	389
,, docked	210
Total gross tons docked and repaired during the year	2,105,364

Machinery Manufacture.—Concurrently with the building and repairing of vessels the works specialises in the production of a wide range of machinery, both for marine and land purposes.

Hikoshima Works.

This plant is on an island of that name situated between the ports of Moji and Shimonoseki, and occupies an area of over 13 acres facing the islet named Ganryujima, which forms a natural breakwater, and the principal industries carried on at it are repair work and the construction of fishing craft.

There are three concrete docks, No. 1 being 368ft. long, No. 2 463ft., and No. 3 265ft.

As to the building of fishing craft, to which reference has been made, it should be mentioned that, when this plant was laid down, one of the objects in view was to cater for the requirements of the great fishery industry centred around Shimonoseki. The hopes entertained in this regard have been fully realised, and up to the present time more than fifty such vessels, comprising fishing boats, patrol vessels, &c., have been built and put into service,

A notable tendency in recent years has been the demand for very large fishing craft, and because of the long experience and the special facilities possessed by this shipyard, the plant has been fully booked up with work for a long time. At present twenty-six vessels are on order, six of which are each of about 400 tons gross.

Arms Works.

This establishment, situated in the city of Nagasaki, where torpedoes and other implements of war are manufactured, was opened in 1917, and has a torpedo testing station in the bay of Omura.

Research Laboratory.

With a view to keeping abreast of the every-day progress of science and industry, the company established a research laboratory in August, 1919, in Tokyo, where very useful and interesting researches are carried on. Studies at present are directed mainly to chemical, electro-chemical, mechanical, metallurgical, and physical investigations.

Diesel Engines.

The company has long engaged in the manufacture of Diesel engines on the Vickers four-stroke airless injection principle, but until a few years ago, these were confined to naval application only. In view, however, of the trend of the times, the company, in 1924, entered into a manufacturing agreement with Sulzer Brothers, of Winterthur, Switzerland, whereby the complete manufacturing knowledge and experience for their two-cycle engines was acquired. The first manufacture under this licence comprised two sets of 2300 B.H.P. engines, which were installed in 1926 in the motor ship "Montevideo Maru," built at the Nagasaki Shipyard for the Osaka Shosen Kaisha. These were the first engines of big capacity ever built in Japan for mercantile use. Manufacture completed on the Sulzer system alone up to the present time, including engines on order, amounts to 34 sets of a total B.H.P. of 167,400 in 220 cylinders.

The company now manufactures the Vickers type for naval, mercantile and land purposes at Kobe Works, and the Sulzer type at both Nagasaki and Kobe.

Welfare Work.

The greatest attention has always been paid to the welfare of the workers in the Mitsubishi Works, and the "Workmen's Protection and Welfare" organisation affords ample aid and assistance in cases of injury, sickness, retirement and death, as well as marriages and births in the families of the workers. Nagasaki, Kobe and Hikoshima Works each possesses its own well-equipped hospital, where employees as well as their families can receive advice and treatment.

With the object of assisting employees as far as possible to combat against the high cost of living, each works has in operation a system of provision stores—named in the vernacular "shaso"—which not only enables the workers to procure rice and groceries, but other every-day necessaries of life, at a cost much below market prices. As a means of encouraging thrift, a savings bank has for a long time been in existence, a comparatively high rate of interest on deposits being given as an inducement.

The management has ever bent its efforts to improve the intellect of the workmen, as well as to provide every possible facility for physical culture, training and recreation. Each of the works has a Workmen's Club House, in which are to be found a reading-room, library, recreation hall, as well as baths. Well-equipped sports grounds, tennis courts, judo and fencing halls, and the like, form some of the facilities available. Lectures are given from time to time on various subjects, such as literature, moral culture, public health, &c.

Worthy of mention here is the "Works Committee," the members of which are elected by the workmen themselves, each trade being represented by a number of members. It meets periodically and lays before the management any suggestions it may have to make for bettering the lot of the workers and for furthering the efficiency of the works. Much good has accrued from the deliberations of this committee, and the relations between the employers and workers are of a most harmonious nature.

Schools.

The company has two technical schools, one at Nagasaki and the other at Kobe, where elementary technical education is given free of charge not only to the sons of workmen employed by the firm, but also to those of the general public. The school at Nagasaki has accommodation for 1200 boys and that at Kobe for 400.

THE MITSUBISHI HOSPITALS AT AKUNOURA AND FUNATSUMACHI

Canadian Engineering News.

(From our own Correspondent.)

Churchill Harbour Facilities.

Announcement has been made by the Department of Railways and Canals that a 2,000,000 bushel grain elevator will be built at Churchill Harbour, the northern terminus of the Hudson Bay Railway. It is intended that it shall be of the most rapid transfer type available. It is expected that foundation work will be started next summer, and that the elevator and a portion of the deep water dock will be available for the autumn of 1931. Meanwhile further necessary attention will be given the question of aids to navigation through the bay and strait, and to other questions connected with the institution of an ocean service *vid* the new route.

As to the railway itself, the engineers are nearly a year ahead of where they expected to be when they started out to complete the enterprise three years ago, but while the first lift of ballast has been completed over the Churchill extension, much further track work will be necessary before the roadbed will be consolidated and safe for regular service with standard equipment. The dredging at the harbour, which will necessitate the removal of some two million cubic yards, is proceeding rapidly ; two big dipper dredgers with eight-yard buckets are working day and night. An average of nearly 6000 cubic yards has been removed daily during the season, and on certain days, 8000 cubic yards were handled. Over 900ft. of inside crib has been sunk in place, and by early next season it is expected to have the crib seat sufficiently dredged to start the building of the outer crib wall with 32ft. of water alongside at extreme low tide. This will greatly aid the progress of further port development.

Standardisation of Port Facilities.

At the eighteenth annual convention of the American Association of Port Authorities, held in Quebec City in September, it was reported that a technical committee on the standardisation of port facilities had been created by the American Marine Standards Committee, and that it is now obtaining suggestions as to designs of port equipment or facilities susceptible of standardisation. Various suggestions have been received, and preliminary consideration is being given to such equipment as mooring bitts, cargo masts, water connections, hardware, and winches, with intention to extend the work to cover railway track construction, transit shed doors, cables for apron wharves, concrete and wooden sheet piling construction, dredging specifications, mechanical handling equipment, &c.

To Enlarge Noranda Plant.

The Noranda Mines Corporation is proposing to increase the capacity of its concentrator from 500 tons to 1000 tons per day. The 500-ton plant is now handling 250 tons to 300 tons per day, the amount being limited by shaft capacity. The 1000-ton concentrator is intended to handle the low-grade milling ore around 2 or 3 per cent. copper.

Another Bridge Over Detroit River.

New plans for the construction of a bridge across the river Detroit between Amherstburg, Ontario, and Grosse Point, Michigan, have been officially approved by the United States War Department, and have been submitted to the Canadian Government engineers for their approval. The original plans for the bridge were got out by the engineers of the Detroit River Canadian Bridge Company, and included spans 852ft. in length over the Livingstone and Amherstburg channels with several piers in the shoal waters between them. The United States army engineers considered objections from the shipping interests of the river, which declared that the span on the Amherstburg channel, particularly, would dangerously narrow the available waterway, and that the horizontal clearance would be much too small. They urged that there should be only two spans, and that each should be 1200ft. in length. The arbitrating engineers have ordered that

the spans should be 912ft. long, and that there should be three of them. This alteration means that there would be but two piers in the river, and two abutments, and would increase the cost of the bridge considerably.

Harbour Improvements.

Chicoutimi Harbour, which is the furthest point on the Saguenay River in the Province of Quebec that large ocean-going boats can reach, is being enlarged and made suitable for the largest types of Transatlantic steamships, and the Canadian National Railway terminus there will be shifted from its present position so as to operate in conjunction with the new harbour facilities. A stretch of shore-line, a mile and a-half in length, which forms a shallow bay, is being filled in and a seawall built alongside it at which ocean liners may dock and transfer their cargoes to the adjacent railway sheds. Dredging is constantly being carried on in the heavy clay bed of the Saguenay River, and at low tide large gangs of men are engaged on the crib work of the new seawall.

Rapid Growth of Flying.

The rapid growth of airmindedness in Canada is indicated by the fact that members of light aeroplane clubs in Canada flew more than 10,000 hours during the first nine months of the year. Figures made available by the civil aviation branch of the Department of National Defence show that, to date, the flying time of clubs has exceeded by nearly 2000 hours the total time in the air during 1928. A hundred and ninety-two new private and fifty-seven commercial pilots have graduated from the ranks of the students in the clubs. In 1928 the figures at the end of the year showed 111 private pilots and twenty-eight commercial. This year there are twenty-two clubs in actual operation as against fifteen last year.

Sewage Collector System.

One of the largest sewerage projects in the city of Montreal is the Back River collector system, the first unit of which is under construction, and for the remainder of which plans are now in course of preparation. Work on the main trunk will commence early next year, it is expected. Upon the completion of the collector system and the accompanying sewage treatment plants, the Back River will be free of sewage pollution to which it is now exposed, since nine sewers discharge into the river. The new network of sewers will also serve to drain and dry up a number of low-lying areas in the Back River district.

Canada–Detroit Tunnel.

Rapid progress is being made with the tunnel which is to form the under-water link between Detroit, in the United States, and the Border Cities on the Canadian side of the Detroit River. Five 250ft. segments of the tube have been sunk in the river bed and connected. Of the remaining four segments necessary to complete the river portion of the tunnel, the sixth is nearly ready to be lowered into position, while the last three are in various stages of construction. The shield-driven section on the Detroit side, 489ft. long, is completed. Connection with the land end of the first tube is practically finished. The approaches in both cities are progressing rapidly and the engineers report that they will be finished ahead of schedule. The foundations for the Detroit ventilating buildings are practically completed, and concrete for 60 per cent. of the interior longitudinal walls is poured.

C.P.R. Builds More Lines.

Rapid progress in construction of new railway lines in Western Canada by the Canadian Pacific Railway is indicated in the statement of D. C. Coleman, vice-president, that more than 365 miles of new lines were completed and turned over to the operating department between June 15th and September 16th. This mileage does not include an additional 370 miles under construction on which 111 miles of steel has already been laid.

To Test British Columbia Coal.

Tests of British Columbia coal to determine whether it is suitable for use in pulverised form will shortly be conducted at the Mines Research Laboratory at Ottawa. Coal in pulverised form is in demand by Canadian pulp and paper mills, sugar refineries and other plants using large steam boilers.

Boiler Making in London.

IT is, of course, generally recognised that there is a tendency for industrial processes to migrate from the North and Midlands to the South of England, but we were somewhat surprised on the occasion of a visit to the Woolwich works of G. A. Harvey and Co., Ltd., to discover that there is in London an equipment for the manipulating of heavy plating which compares with that of many establishments in the Black Country. Again, we were rather surprised to find that a London firm, which must, of necessity, draw its supplies of raw material from works some hundred or so miles away, could be in a position to export bulky things, such as digesters, to the United States, regardless of the import tariff. That is, nevertheless, what is going on at Woolwich, and it is an encouraging thought that the Thames Valley is coming back to its old pre-eminent industrial position.

At the works of the Harvey Company in Woolwich a very wide variety of products is made, and our readers are familiar with such items as galvanised ware and perforated metal, and in connection with the latter material we would like to have explained the construction of the punches and dies, which may make some thousands of perforations in one operation, and then register exactly for the next stroke; but this is obviously a matter which the firm does not wish to be disclosed.

However, our concern at the moment is the new shop which the company has put up for comparatively heavy plate work. This shop occupies an area of 100,000 square feet under three bays, and accommodates some plant which is still rather unusual in the South Country. Thus, there is a 750-ton hydraulic press capable of flanging out steel plates up to 9ft. 6in. in diameter, and incidentally dishing them in one operation, with the usual appurtenances in the way of a furnace and cranes.

Again, speaking of large-sized "stuff," there is a set of bending rolls which is capable of handling such sections as 6in. by 6in. by $\frac{7}{8}$in. angles cold and bending them into rings of any desired diameter. Some other large machines in the shop comprise a set of bending rolls, which will take plates up to 15ft. wide by 1$\frac{1}{4}$in. thick, with horizontal rolls and an end housing that may be swung out of the way, so that a complete tube may be drawn off the rolls; a bending press which can take plates 10ft. wide by $\frac{3}{4}$in. thick, and a guillotine which will cut plates of a similar size.

Besides the heavy plating work which is indicated by the above cursory description of the plant, the company also does in this department a number of other jobs, and among them there is included the manufacture of gilled tubes for electric transformer cooling and similar purposes. The application of the spiral gills to these tubes is a rather interesting process. The tubes are plain, solid drawn steel, and are put into a lathe in which they are gripped by a chuck at one end, and are steadied by a rest at the other end. The rest also embodies a guide, by means of which the radial helical fin is led on to the tube.

In the process of construction the end of the strip is first welded, autogenously, on to the tube, and the assembly is then put in the lathe. The strip is put in the guide associated with the steady rest, which is mounted on the slide rest of the lathe. The machine is then started and the strip is forcibly wrapped round the tube, standing on edge. There is naturally a surplus of material in the inner circumferance of the helix, but this is accommodated by a wavy buckling, which is remarkable in its regularity. The buckling incidentally provides a buttress-like formation which helps in keeping the strip upright, and gives a good contact between the fin and the tube for the conduction of heat. At the end of the coiling there seems no marked tendency for the strip to uncoil off the tube, but it is tack-welded for security.

In making boilers, tanks, and so forth, all the rivet holes are drilled, generally with the assistance of a template, and we noticed that single-spindle drilling machines are preferred, as the work done in the shop is of such a varied character that multiple spindle drills are not justified. The drilling is carried out with a very high rate of feed, but it is evident that the drills themselves are kept in good order, for we saw hardly any appreciable arris on the lower side of the drilled plates. After being drilled, the plates are taken to an edge planing machine, which can accommodate plates up to 30ft. long by 8ft. wide. It has two heads, which work simultaneously on the front and end of the plate. The corners of plates, which will overlap when assembled, are not tapered out by forging in the old-fashioned manner, but are accurately milled in a special machine with a head that can be set at any angle. The edges of flanged circular ends are turned in a mill, which is capable of accommodating pieces up to 12ft. in diameter, and has an attachment for boring oval manholes, &c.

For closing rivets there are at present two hydraulic machines, one with a 10ft. 6in. and the other a 6ft. 6in. gap, which are capable of dealing with rivets of 1$\frac{1}{8}$in. and 1in. diameter respectively. Arrangements are, however, being made for the installation of a machine with a gap of 15ft., which will be able to close rivets up to 2in. in diameter. It will then, of course, be possible to rivet shells up to 30ft. in length and the crane capacity in the riveting bay is such that jobs of a weight up to 25 tons can be handled.

An important section of the new shops is that devoted to laying out plans, where there is a good floor, measuring 120ft. by 60ft., so that complicated shapes of plates may be drawn out to full scale and appropriate templates prepared.

Group Life Assurance for Employees.

A GROUP life assurance scheme is now in operation throughout the organisation of the Consolidated Pneumatic Tool Company, Ltd., of Fraserburgh, Scotland, and London, which is providing protection to the dependants of workers in amounts ranging from £100 to £1000. All employees of the company who are actively at work are eligible to join the scheme irrespective of age, sex, or physical condition, and out of the 600 employees of the company the majority have joined. The assurance is payable on death from any cause while in the service of the company, or in the event of total and permanent disability before the age of sixty the assurance will be paid directly to the assured in forty to sixty monthly instalments. All employees who join the scheme are divided according to earnings into one of five groups, with life assurance and employee's weekly contribution, as in the following schedule :—

Class.	Annual earnings.	Life assurance.	Employee's weekly contribution.
A	Under £150	£100	0s. 3d.
B	£150 up to £250	£200	0s. 6d.
C	£250 up to £400	£300	0s. 9d.
D	£400 up to £650	£500	1s. 3d.
E	£650 up to £1000	£750	1s. 10½d.
F	£1000 and over	£1000	2s. 6d.

The total cost of the scheme over and above the employees' weekly contribution will be paid by the Consolidated Pneumatic Tool Company.

In the event of total and permanent disability before the age of sixty the total of the life assurance will be paid directly to the assured in monthly instalments as follows :—

Amount of life assurance.	Number of monthly instalments payable.	Amount of each monthly instalment.
£		£ s. d.
100	40	2 12 6
200	60	3 12 0
300	60	5 8 0
500	60	9 0 0
750	60	13 0 0
1000	60	18 0 0

If an employee who is a member of the scheme leaves the company's service the assurance company agrees to give him an individual policy without medical examination for the same amount at the standard rate for his attained age, if application for such policy is made within thirty-one days.

An unusual feature of the scheme is that all members of it are entitled to free nursing service. The assurance company provides a staff of highly qualified visiting nurses, who will, in cases of illness or disability, call at the home, assist in carrying out the doctor's instructions, and give any assistance feasible. There is no charge or deduction of any kind for this service and the nurses only call at the direct request of the employee.

This group assurance and other benefits in no way supersede or conflict in any way with any National Insurance, Workmen's Compensation Law or any other present benefits, but are in addition to them.

The scheme has been placed with the Metropolitan Life Insurance Company of New York, which is a mutual company without shareholders entirely owned by its policy holders. All of its funds relating to British business are retained here by and under the sole control of British trustees.

Felling a Concrete Chimney Stack in America.

THE following account of the felling of a tall reinforced concrete chimney stack by blasting is taken from our contemporary *Engineering News-Record*.

"Surrounded by a creek, two main streets and a railroad, a 166ft. reinforced concrete stack of the Florida Power Corporation at St. Petersburg was successfully razed and dropped within a narrow required space by blasting. . . . The stack, 12ft. 8in. in diameter at the base, was so situated that two of the main streets of the city were within reach of its fall.

"Because of the necessity of dropping the stack within close limits, it was necessary to put a cable at the top pulling in the required direction of fall. The method used by a steeplejack in fastening this cable to the top of the stack proved interesting. There was no ladder either inside or outside of the stack and the only access to the top of the structure was by means of a copper wire serving as a ground for lightning rods. A series of wooden strips, 1in. by 2in. by 16ft. long, with a wing nut at each end was pushed, in succession, up the outside of the stack, being fastened to the lightning cable by means of wire loops.

"The first strip carried a pulley and rope. As the strips were pushed up the rod they were fastened to each other by the wing nuts, and strip after strip was added at the bottom until the pulley and rope had reached the top. By using this rope the steeplejack pulled up another wooden strip with a large iron hook, to which was attached another pulley and a heavy line. The hook was hoisted to the top of the stack and manœuvred around until it fell over the top rim. By means of the heavy line the steeplejack hoisted himself to the top of the stack and fastened a $\frac{3}{4}$in. cable around the outside just below the rim. The other end of this cable was fastened to a deadman and to a $\frac{1}{2}$in. line operating from a hoisting engine. This arrangement assured complete control of the falling stack.

"The centre line of the stack was marked near the ground on the line in the required direction of fall. On the side toward which the stack was to fall two lines of holes were drilled, the first line being about 2ft. above the ground and the second about 1ft. above the first. The holes were drilled approximately 12in. apart, equally spaced on both sides of the centre line. These holes, 2in. in diameter, were drilled about two-thirds of the way through the wall of the stack and were used as blasting holes. On the opposite side of the stack a series of weakening holes were drilled, eight in all, approximately 6ft. from the ground, symmetrical about the centre line, and drilled completely through the wall.

"Half a stick of 60 per cent. dynamite was used in each of the blasting holes. In the first blast four holes were shot at the centre, in the next two blasts eight holes were shot at one time, four on each side of the centre line, and in the succeeding blasts four holes were shot at one time, two on each side of the centre line. Seven blasts were required before the base of the stack had been weakened sufficiently for the structure to fall. After each blast a strain was put on the cable by the hoisting engine with 3ft. to 4ft. of cable taken up at each strain. After the seventh blast the stack stood for approximately thirty or forty seconds and then fell. The top of the stack fell within 3ft. of the stake which had been set as marking the spot where it should fall.

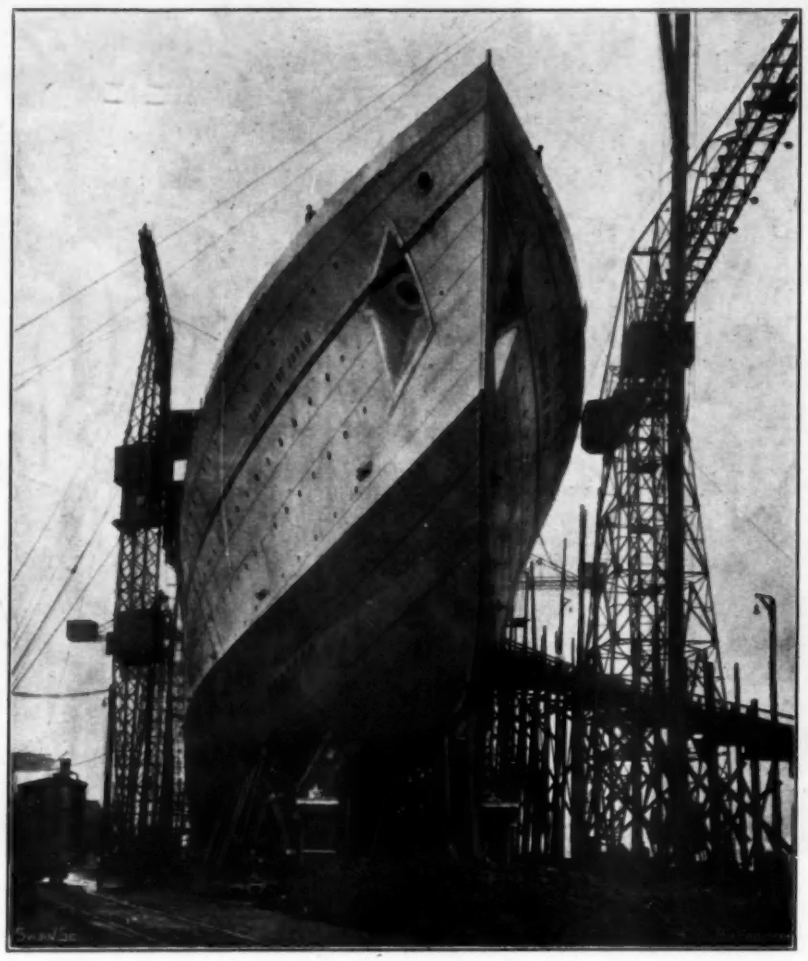
"The stack was expected to fall as a rigid mass and to strike the ground in one piece. However, . . . it broke in the centre when reaching an angle of about 45 deg., the top section striking the ground before the base. The top section was broken into fine pieces, part of it being completely pulverised. The bottom half was fairly well broken at the midpoint, while the base was only partly broken, part of it remaining in sections large enough to require additional blasting to be removed. The reinforcing rods at the base were found to be pulled out of the concrete at the splice points near the base and were not broken. Possibly this was due to the fact that the rods were plain and not deformed or twisted.

"The time required for the fall was approximately fifty-seven minutes from the time of the first blast. Progress conformed exactly to a predetermined schedule."

THE manufacture of synthetic camphor on a commercial scale by the Belle Chemical Company, Belleville, N.J., is, states the *Oil, Paint, and Drug Reporter*, expected to be an accomplished fact by January 1st. The initial production will be between 500 lb. and 1000 lb. a day. The present plant would permit an increase to 2 tons per day without alterations, and with a modest expansion the output could be raised to 4 tons per day without entailing much expense. Camphor is, of course, largely used in the manufacture of celluloid.

TWIN-SCREW CANADIAN PACIFIC LINER "EMPRESS OF JAPAN"

FAIRFIELD SHIPBUILDING AND ENGINEERING CO., LTD., GOVAN, BUILDERS AND ENGINEERS



The Canadian Pacific Liner Empress of Japan.

ONE of the most important launches of the year took place at the yard of the Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, on Tuesday last, December 17th, when the new 26,000-ton twin-screw express liner "Empress of Japan," which is being built for the Trans-Pacific service of the Canadian Pacific Railway, safely took the water. In the accompanying engraving we reproduce a view of the bow of the ship as she appeared in the stocks shortly before preparations for launching her were made. Early on the day of the launch there were some fears that, owing to the fog which enveloped the river, the launch would have to be delayed, but about 12.30 p.m. the ceremony of naming the ship was performed by Mrs. E. R. Peacock, the wife of one of the C.P.R. directors, and the ship immediately began to move, and quickly disappeared down the ways into the fog.

The new liner has been specially designed for the Canadian Pacific fleet, and when completed she will be the largest and fastest steamship in that service. Her propelling machinery will comprise twin-screw, single-reduction, geared turbine machinery, with high-pressure Yarrow boilers, combined with Scotch auxiliary boilers, the general machinery installation being similar to that so successfully designed by Mr. J. Johnson, the company's Chief Superintendent Engineer, for the "Duchess" class liners. A slightly higher steam pressure and steam temperature has been chosen, and, with one or two minor exceptions, electrically driven auxiliary machinery will be employed throughout. The principal dimensions of the new liner are as follows :—

Hull Particulars.

Overall length	666ft.
Breadth, extreme	87ft.
Depth to "A" deck	56ft.
Service speed	21 knots
Gross tonnage	26,000

Passenger Accommodation.

First-class passengers	400
Second-class passengers	164
Third-class passengers	100
Asiatic passengers	548

Propelling Machinery.

Type: Twin-screw, single-reduction, geared Parsons type, three-stage turbines	
Total output	30,000 S.H.P.

Boiler Installation.

Number of H.P. Yarrow water-tube boilers	Six
Working pressure	425 lb./sq. in.
Superheat temperature	725 deg. Fah.
Number of L.F. Scotch auxiliary boilers	Two
Working pressure	200 lb./sq. in.

Auxiliary Machinery.

Number of turbo-generators	2 at 600 kW
Number of oil engine driven generators	4 at 300 kW

The latest navigating and safety appliances are to be fitted, and the lifeboat equipment, which includes two motor lifeboats and two emergency lifeboats, is to be sufficient for the whole of the passengers and the crew.

There are six main decks, running fore and aft, above which are the boat and promenade decks, each over 300ft. in length. The navigating bridge is about 68ft. above the water line of the ship, and the navigating equipment will include, beside the directional wireless installation, gyro compasses, submarine signalling apparatus, clear-view screens, and other refinements. Particular care has been taken to provide large promenade spaces for all classes, and first-class passengers are to have no less than 31,000 square feet of such space for their use. This space includes the covered promenade and boat decks, above which there will be a sun deck, which may be used for sports. The ship will carry three funnels, which will give her a handsome appearance. Both in her cabins and public rooms the liner is to be luxuriously fitted, and she will be outstanding among her sister ships in this respect. Her auxiliary machinery equipment will include a large refrigerating installation by J. and E. Hall, Ltd., of Dartford.

As indicated in the above table, the propelling machinery will be of the latest Parsons type, comprising twin-screw units, each consisting of a high-pressure, intermediate, and low-pressure turbine in series, designed to use steam at a pressure of 375 lb. per square inch, and a total superheated temperature of 700 deg. Fah. The Weir type of regenerative condenser will be fitted, and other engine-room auxiliaries have also been chosen for their high economy and reliable working. As above stated, both steam turbine driven and oil engine driven generator sets are to be installed, giving a flexible and economical supply of power. The boilers, both of the Yarrow high-pressure and of the Scotch auxiliary types, are designed for oil burning only, and it is of interest to know that the fuel bunkers, when filled, will amply suffice for the whole of the Pacific voyage, a distance of 13,000 miles.

At the luncheon which followed the launch, a very large company of guests was present, and the toast of the new liner and her owners was proposed by Sir Alexander M. Kennedy, the chairman and managing director of the Fairfield Company, and was responded to by Sir George McLaren Brown, K.B.E., the European Manager of the Canadian Pacific Railway. In proposing the toast of the builders, Captain James Gillies, the General Manager of Canadian Pacific Steamships, Ltd., made some interesting references to certain technical aspects of ship propulsion. The recent spell of tempestuous weather had, he said, served to remind all of us of the difficulties which attend the propulsion of large high-speed liners operating in Atlantic service. It was becoming apparent, he thought, that a four-day Atlantic crossing—the limit for surface ships, for both physical and commercial reasons—was being approached. The problem of driving such ships at a speed such as that of the "Bremen" was an engineering one. It was necessary to accommodate a very large horse-power in the smallest possible compass, with the minimum of weight compatible with reliability and durability, and with such an efficiency that the requisite bunkers could be carried. Further important considerations were those of damage or depreciation through the vessel being hard driven throughout the year, the motion of the ship in a seaway, and its safe navigation. With regard to the "Empress of Japan," although she would have a service speed of 21 knots, it was expected that an additional speed of at least 1 knot would in favourable weather be registered. The passage between Vancouver and Yokohama, a distance of 4200 miles, would be made in eight days, or a day less than with the earlier liners. The new liner "Empress of Britain," which was being built by John Brown and Co., Ltd., at Clydebank, and will be commissioned early in 1931, was designed to make the passage from Southampton to Quebec in five days, thus shortening the Atlantic part of the journey. With regard to advances in propelling machinery, it was of interest to reflect that in the "Empress of Canada," built by the Fairfield Company in 1922, the machinery weight was 3400 tons, with permanent bunkers of 6100 tons, for a speed of 19 knots and 20,000 S.H.P., whereas with the "Empress of Japan" the machinery would weigh only 3200 tons, with permanent bunkers of 6100 tons, for a speed of 21 knots, and 30,000 S.H.P. The progress which had been made by Sir Charles Parsons and Mr. J. Johnson with high-pressure geared turbine machinery had resulted in new records being established, first by the "Empress of Australia," and later by the "Duchess" class of liners, and in the case of the "Empress of Japan" a new record was looked forward to. He did not think, however, that the last word had been said with regard to the high-pressure turbine system of propulsion, and important developments in boiler design were foreshadowed which would increase the commercial efficiency of the propelling machinery and enlarge the radius of action of large passenger liners, intermediate liners, and fast cargo steamers. In conclusion, Captain Gillies paid high tribute to the Fairfield Company's organisation and staff, the capacity of the firm for rapidity of production. The new liner would be the first of her type in the North Pacific Ocean to be propelled by high-pressure steam machinery, and he felt that she would be worthy illustration of her builders' all-round shipbuilding and marine engineering capacity.

Institution of Mechanical Engineers

NORTH-WESTERN BRANCH.

THE annual dinner of the North-Western Branch of the Institution of Mechanical Engineers was held at the Engineers' Club, Manchester, on Thursday, December 12th. The attendance of members and guests was the largest on record for this branch, and included Dr. Adamson, president, the Lord Mayor of Manchester and Dr. W. H. Moberly, vice-chancellor of the University. The toast of "The Institution" was proposed by Dr. Moberly, who said that the work of the Institution was similar in the main to that of the other great professional societies which played so large a part in the life of the country. They all protected their legitimate interests. They helped to keep a high professional standard and spent money upon research and technical education.

In reply to the toast, Dr. Adamson, speaking of the work of the University, said no university had done so much as that of Manchester in strengthening the bonds between the University and the special interests of the City. Owing to the increasing numbers of members of the Institution and the great number of applications, it was really important that each individual member should realise his responsibility and study the applications which were printed in the monthly journal, and write if he had anything against a prospective member, so that they got the right quality of members. If the Membership Committee made mistakes, it was due to want of evidence and to the fact that individual members had neglected their duty. The development of the local branches was making a great change in the Institution.

The toast of "The Guests" was proposed by Mr. Sterry B. Freeman. In the course of his remarks Mr. Freeman said they in Liverpool watched very closely what Manchester was doing and followed at a respectful distance. Liverpool and Manchester Universities were in close alliance. They were friends and neighbours, and they were also rivals, but it was a friendly rivalry in carrying on the service of learning and maintaining the arts and services which had been handed on to them. In reply, the Lord Mayor—Councillor R. Noton Barclay—said that he thought that all local authorities should get busy to unite in the common interest, and endeavour as far as possible to unify their services. Might not a good deal be accomplished with their various societies? He understood that there were civil engineers, mechanical engineers, and electrical engineers—with three separate institutions. Might not a good deal be accomplished by centralising the administration of those societies? He believed that that was accomplished on the other side of the Atlantic in New York. They had practically done that in Manchester in the Engineers' Club, where all sections were brought together, and they had managed to live together in harmony.

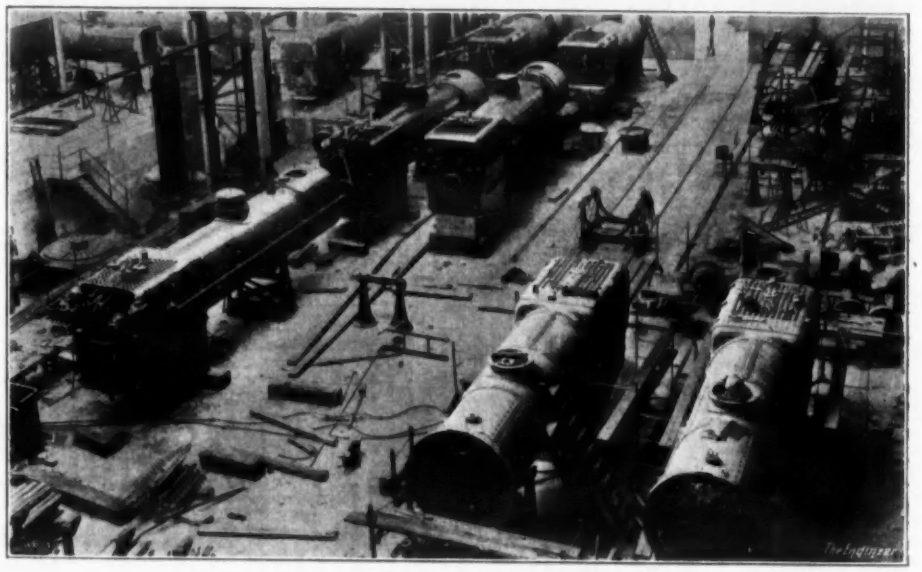
The toast of "The Chairman," Mr. H. L. Guy, was proposed by Mr. G. H. Sheldon, chairman of the Graduates' Section, who referred to Mr. Guy as a guide, counsellor and friend. Mr. Guy, in reply, said that the Graduates' Section was a most important activity in the Institution, for it was with the graduates of to-day that the future of the Institution lay. If he knew aught of the coming generation of engineers, he felt that the future was in safe keeping. He hoped the older members would not fail them in the present. He said the year which was passing had been an important one for the Branch, in that it gave the local members the opportunity for the first time in its history of welcoming the Institution at a summer meeting.

IN a recent issue of the *Zeitschrift für Technische Physik*, Herr H. Schmick describes a method for measuring gas temperatures, based on the fact that when a gas is passed through a valve at a certain speed the pressure difference is approximately proportional to the absolute temperature.

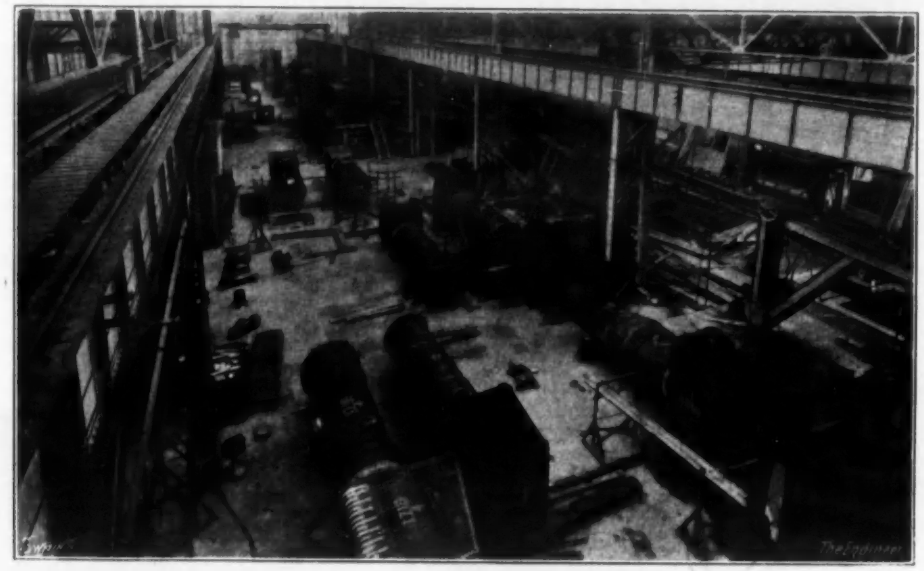
NEW BOILER SHOP AT THE SCOTSWOOD WORKS

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LTD., NEWCASTLE-ON-TYNE, ENGINEERS

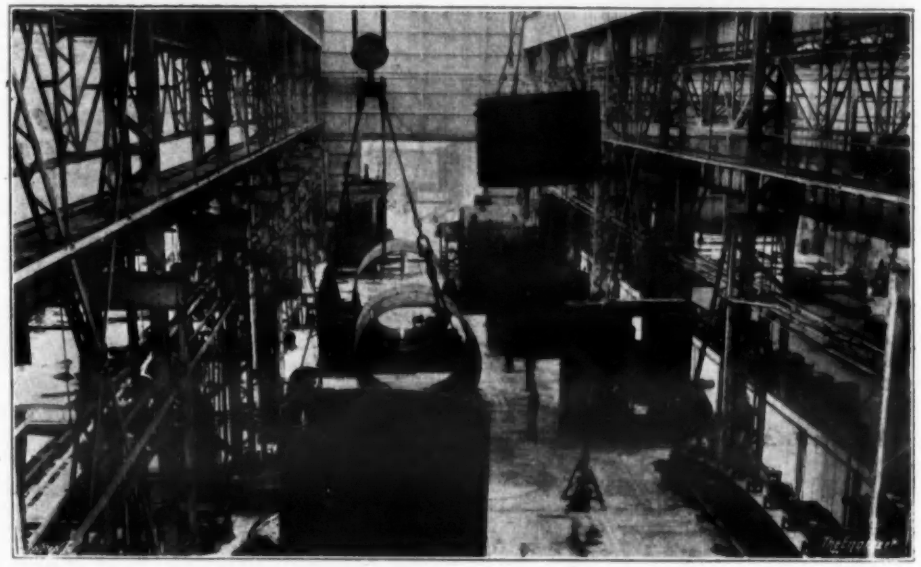
(*For description see opposite page.*)



LOCOMOTIVE BOILER TESTING BAY



MIDDLE BAY, LOCOMOTIVE BOILER SHOP



MARINE BOILER SHOP—BENDING AND DRILLING MACHINES

MARINE BOILER SHOP—FLANGING DEPARTMENT

SCOTSWOOD WORKS, 100-TON LOADING AND SHIPPING GANTRY

Scotswood Boiler Shop.

IN our issue of September 6th, 1929, we illustrated and described a new boiler shop which has been built by Armstrong, Whitworth and Co. (Engineers), Ltd., at their Scotswood Works. We now propose to give some account of the equipment and of the work carried on in these new buildings, which are illustrated in the engravings given herewith and on pages 660 and 664. The shops themselves have been in operation since the beginning of this year, the locomotive and marine boiler work prior to that time having been carried on at the Elswick Works. On the occasion of a recent visit the shop was full of work, practically every machine being in operation.

The new shops comprise three bays, covering an area of 13,500 square yards, fronting the River Tyne throughout their length, and separated from the bank of the river by a strip of ground with railway accommodation. The railway track conveys finished material from the "finishing" end of the shop back to the starting point, and thence to the erecting shop. When boilers are to be dispatched overseas, they are taken out of the shop on trucks and run under a gantry—illustrated above—projecting over the river. This gantry is provided with a travelling crane of over 100 tons capacity. The boilers are placed on a shallow draught lighter and taken downstream to deep water, where they are transferred to the ocean-going ship. The dredging of the river so that deep-water craft can go right up the river to Scotswood and be loaded directly at the gantry is in contemplation.

In passing, it may be mentioned that the gantry is used not only for the dispatch and receipt of boilers and relatively light loads, but also for the dispatch of complete locomotives, which are run out from the erecting shop under the gantry and there slung on board a lighter, special lifting beams and slings being used for the purpose.

Having dispatched the finished product, we may now return to its origin. Very little stock of steel plates is held. This is due to the diversity of plate sizes required and the expedition with which they can now be obtained from the rolling mills. We were told, for instance, that in the case of plates being required of unusual sizes they can be ordered and delivered at the boiler shop within eight days, so that but little is gained by keeping a big stock. All plates are "mangled" on arrival at the boiler shop in a machine which is indicated on the plan near the west end of the north bay, and is also shown in one of the half-tone engravings.

The marine and locomotive boiler sections are kept quite distinct. The marine boilers are made in the west end of the two south bays, while the locomotive and other boilers utilise the full length of the north bay and the east end of the two south bays. The two sections are quite distinct in their staff and immediate supervision.

LOCOMOTIVE BOILERS.

In the locomotive section there are employed about 325 men, the potential output being about 400 boilers per annum. The plates, as already noticed, are first "mangled." One of a batch is then taken to the marking-out table and marked out in detail. This marked-out plate is clamped on the top of a bunch and the whole lot is drilled at once. If the size of the order renders it necessary, this process is repeated with other bunches.

For drilling, a number of different machines are used according to the form of the plate. It is noteworthy that all machines have single spindles, as the company prefers them to multiple-spindle machines, since they are more convenient for the diverse spacing of holes. The inside fire-box plates are drilled on a pair of radial drills of 8ft. radius, while the shell plates are drilled on two drills mounted on travelling gantries to command the plate, at least 12ft. by 60ft. There is, besides these, a number of smaller drilling machines which are used for various special purposes.

There are three edge planers which plane the edges of the plates to the proper caulking angle. These machines will accommodate plates up to 35ft. in length. For trimming round the flanges of fire-box end plates there is a horizontal hack saw of rather special design. The plates as they come from the press have a certain amount of surplus material on the depth of the flange. The plate to be dealt with is laid on the table of the machine and packed up to the proper angle. The table has a compound feed motion, and the saw follows round the curves of the flange. The machine makes a very good job, little or no subsequent trimming being necessary.

Prior to flanging, the plates are first cropped round approximately to shape in a shearing machine, being handled during this process by small jib cranes. They are then taken to the furnaces, which are of the gas-fired type. All the end plates are formed by solid dies, or "tools" as they are called on the Tyne. These dies are made in cast iron and may form a considerable item in the cost of boiler construction if the order is small. The firm under review has, however, set a high standard for boiler work and invariably uses machine-flanged plates.

The flange presses are hydraulically operated and situated, as can be seen from the plan and the engravings about the middle of the south bay adjacent to the furnaces. The plates are transferred from the furnace to the press by an hydraulically-operated charging machine, which serves the two furnaces and presses. The shell plates are bent to circles in horizontal rolls, the end housing of which swings back to liberate the finished hoop. There is also a 60-ton vertical bending press in which the bending is effected by squeezing the plate between a vertical roll and a concave platen. The roll and the platen are drawn together by a system of hydraulic rams and toggle levers.

The finished plates for the several parts of the boiler are assembled in the north bay and tack-bolted together prior to final riveting. The rivets are mainly closed in the "riveting tower," which is a tall, vertical extension over a deep pit about the centre of the shop. The extension is 65ft. high from floor level to the underside of the roof ties. In this section of the shop are two vertical hydraulic gap riveters of 24ft. and 17ft. 6in. gap respectively. The riveters are served by two cranes of 30 and 15 tons capacity.

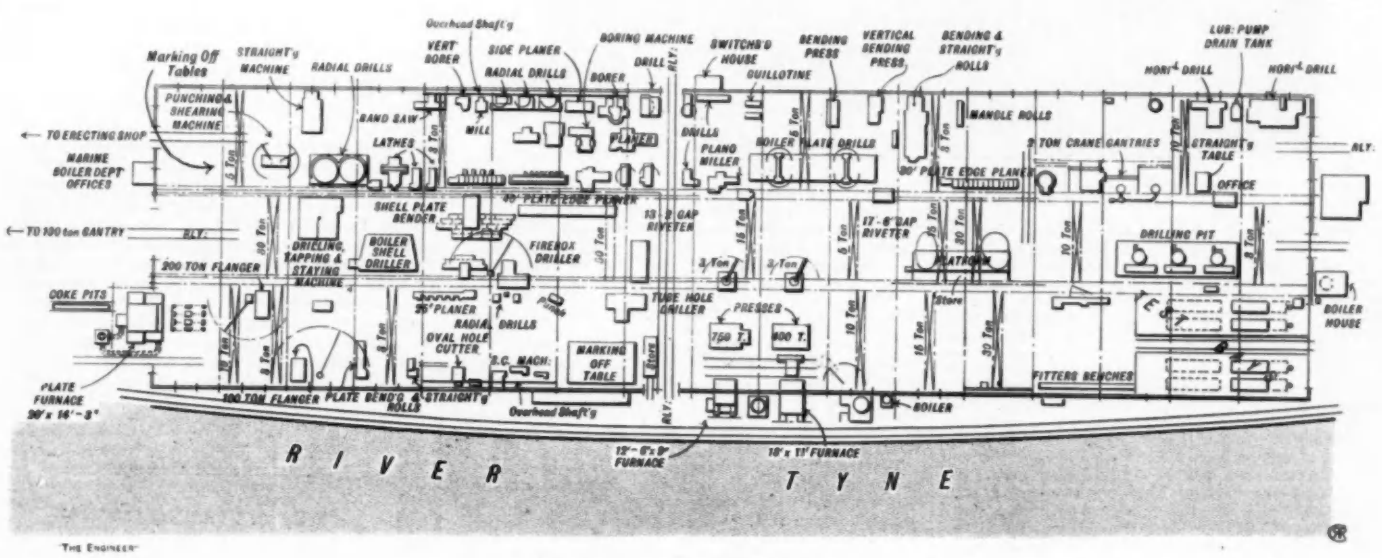
At the working level there is a permanent stage for the operators, and on the stage are the hydraulic controls for the riveting machine and the electrical controls for the cranes. Thus the operator has everything under his immediate control, and it is surprising to note the facility with which the boiler is moved from one rivet hole to another. In the valve mechanism of the riveter is a timing device which ensures that the full pressure is kept on the closed rivet long enough to ensure that it has cooled down sufficiently before the pressure is released. This timing device is independent of manual control. In addition to this large machine, there are smaller riveting machines for special jobs, and two portable machines for closing rivets in foundation rings and fire-hole rings. Wherever possible all rivets are closed hydraulically. There are, however, a few rivets in the narrow water spaces of the fire-boxes for which it is not practicable to use a machine. These are closed by hand by skilled men. Pneumatic riveters are not used for this purpose.

After assembly of the shell and the inside fire-box the water space stay holes are reamed out to size and tapped for the stays. After the boiler is stayed, tapped and mounted, it is sent to the test bed at the east end of the south bay, where there is accommodation for a large number of boilers. The boilers are tested to any required pressure, both by steam and hydraulic pressure. On the occasion of our visit several boilers were under hydraulic test of one and a-half times the working pressure, and careful examination disclosed no sign of even a weep.

The fire-boxes are made of both copper and steel, and we noticed that in all the boilers going through the shops at the time of our visit provision was made for superheaters.

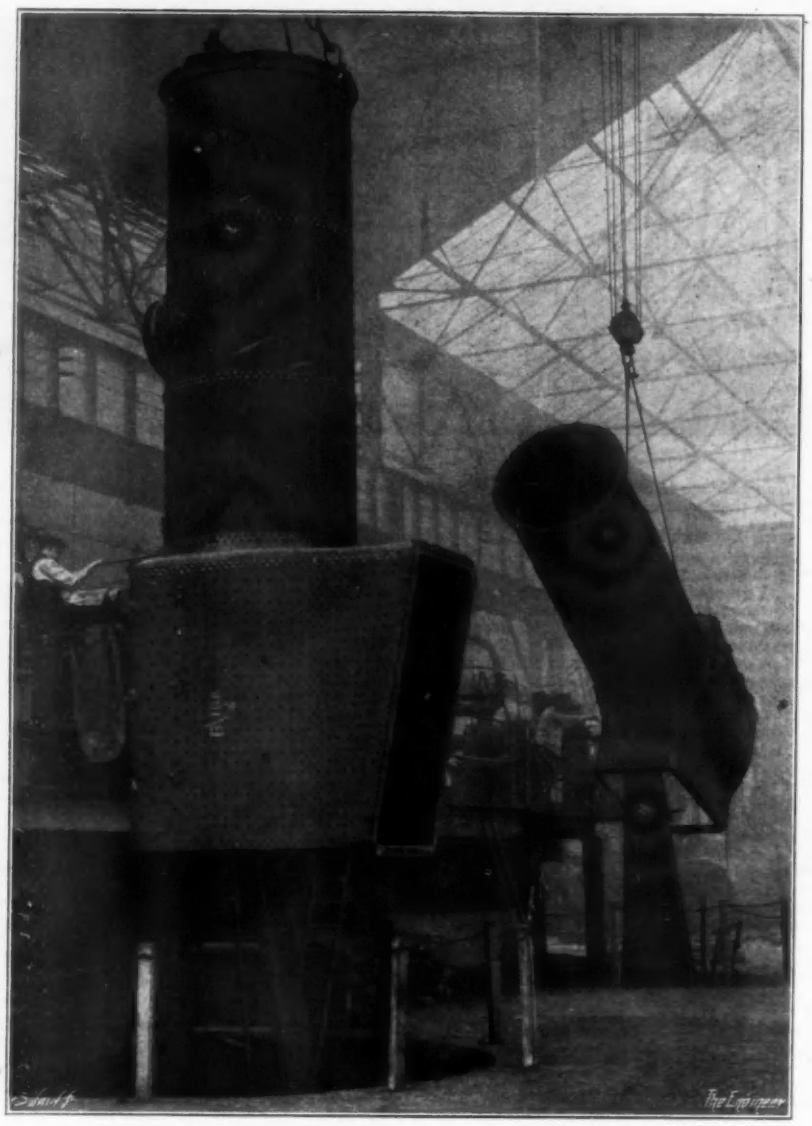
MARINE BOILERS.

The class of work produced in the marine shop is, naturally, rather different from that coming from the locomotive side, principally in the way of dimensions, but the same general procedure of manufacture is adopted. That is to say, the work progresses steadily through the



PLAN OF THE NEW BOILER SHOP

SCOTSWOOD WORKS—RIVETING LOCOMOTIVE BOILER SHELLS



shop, and mechanical processes are adopted wherever possible. There is, however, an outstanding feature of the product of this shop. It is the large size of the individual units and the small number of plates employed in their construction. Thus, the shell of an 18ft. by 12ft. 6in. Scotch boiler requires only six plates. All these plates are approximately 1½in. thick. The circumference comprises one plate 39ft. long by 11ft. 9in. and another 17ft. 3in. The two different dimensions are adopted so that the longer plate may form the bottom part of the boiler and bring the joint above the water line. Each of the ends is made of two plates, of which the lower one is the larger. Before flanging it measures 19ft. 3in. by 13ft. 4in., and includes all the openings for the four furnaces, the manholes, &c. It will be readily understood that the handling of these large plates requires some heavy equipment. Yet these large boilers are being made at the rate of 1000 tons weight in six months, while each individual boiler occupies the shop for about five weeks.

One of the important parts of the equipment in this shop is a large plate edge planer capable of accommodating plates up to 40ft. long, while there is a vertical shell-plate bending machine, shown in one illustration, similar to that already described in connection with the locomotive boiler shop. All the flanging of plates is done by hydraulic power, for which two machines have been installed, one of 200 tons and the other of 100 tons, while there is a drilling machine capable of accommodating two complete boiler shells and drilling several holes simultaneously. A three-spindle machine is used for trepanning tube holes, and other two machines for drilling and tapping the back end plate and the combustion chambers for staying purposes.

Rivets in the shell are closed by a 13ft. 2in. gap hydraulic riveter, and the majority of the rivets throughout the boiler are machine-closed. If specially required, even those rivets connecting the back end and the shell, which are only accessible through the narrow space between the back of the combustion chambers and the end, can be closed hydraulically by a specially designed machine. A circular hole about a foot in diameter is cut in the centre of the back plate and through it a long arm is inserted toa ct as a hold-up. It has an hydraulically-operated telescopic joint so that it may be adjusted for varous diameters. This arm is attached to the framing of an hydraulic riveter which extends outwards and embraces the periphery of the boiler. The whole of this machine is portable, so that it may be slung and worked round the joint.

There is a special machine for cutting oval manholes, &c., and a variety of other machines usually found in a marine boiler shop. The furnace which serves the two flanging presses measures 20ft. by 14ft. 3in., and is coke-fired.

CRANES.

The shop is very fully equipped with overhead cranes to the number of about twenty, the range of capacity being 3, 5, 10, 15, 20, 30, 50 and 80 tons, there being one each of the two latter. The principal cranes have been constructed by Craven Bros. (Manchester), Ltd., with which firm the machine tool business of Armstrong, Whitworth is now incorporated.

The machine tool equipment comprises some eighty machines in all, excluding the smaller plant, and has been supplied by a wide variety of firms, including :—James Archdale and Co., Ltd.; Wm. Asquith (1920), Ltd.; Sir W. G. Armstrong, Whitworth and Co., Ltd.; Henry Berry and Co., Ltd.; The Butler Machine Tool Company, Ltd.; Campbells and Hunter, Ltd.; Carter and Wright; Craig and Donald, Ltd.; Fielding and Platt, Ltd.; Greenwood and Batley, Ltd.; J. Heap and Co., Ltd.; Hulse and Co., Ltd.; H. W. Kearns and Co., Ltd.; Kendal and Gent, Ltd.; J. Lang and Sons, Ltd.; Wm. Muir and Co., Ltd.; Noble and Lund, Ltd.; Royce Ltd.; Scriven and Co. (Leeds), Ltd.; Hugh Smith and Co., Ltd.; John Stirk and Sons, Ltd.; Tangyes Ltd.; H. W. Ward and Co., Ltd.; Charles Wicksteed and Co., Ltd.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—A company of about four hundred ladies and gentlemen assembled last Friday evening at the May Fair Hotel, London, for the annual dinner of the Institution of Structural Engineers. The President, Lieut.-Col. J. Mitchell Moncrieff, was in the chair. The toast list and the speeches were commendably short. Sir Roland Nugent, Director of the Federation of British Industries, proposed "Our Country and Empire." The toast of "Our Guests" was given by Major A. H. S. Waters, V.C., D.S.O., M.C., Vice-president of the Institution, and was responded to by Sir J. Banister Fletcher, President of the Royal Institute of British Architects, in the absence of the Lord Chief Justice, the Rt. Hon. Lord Hewart, who at the last moment was prevented from attending the dinner. "The Institution of Structural Engineers" was proposed by Dr. Daniel Adamson, President of the Institution of Mechanical Engineers, and was acknowledged by Col. Moncrieff. Between the speeches Miss Dora Labbette sang several songs, and following them the guests and their friends danced until 2 a.m. The evening was spent most enjoyably and was in every way successful.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

REGISTRATION OF TESTS.

SIR,—I shall be extremely disappointed if Mr. Parsons' proposals put before members of the Institution of Mechanical Engineers on the 29th ult. do not bear fruit.

No engineer of experience will dispute the statement that from time to time inaccurate performance results obtain publicity, and, although an organisation such as is outlined by Mr. Parsons could not guarantee absolute accuracy, the fact that tests to be submitted for registration would be supervised by independent experts and that the records would have to undergo a critical examination by a committee of experts would go a long way towards removing any possibility of doubt.

I feel sure that manufacturers would welcome this scheme and would make a practice of having the records of tests which have been made for publicity purposes registered in this manner, thus putting a "Hall Mark" on them.

There is already sufficient precedent to show the value of registration. To take one example only, in the State of Nebraska, U.S.A., all farming tractors offered for sale require to be tested on specified lines by the Nebraska University. The collected results of these tests, which are made under conditions which preclude the possibility of inaccuracy, are available and are of invaluable assistance to designers. In Nebraska it is actually compulsory for manufacturers to submit tractors to test before they can be offered for sale, but it is not suggested that this precedent should be followed to the same extent.

I agree with Mr. S. A. Smith that although a test on a large combined plant may involve a great many observers it should not be difficult for the representative of the Registration Authority to observe closely the men and apparatus employed for obtaining the necessary records. In certain cases the employment of an assistant would be justified. On smaller plants such as indicated by Mr. Tookey, which would more usually be the subject for registration, supervision would be simple.

It does not seem likely that registration would add greatly to the cost of tests. At the present time the tendency is for manufacturers to employ consulting engineers of high standing and world-wide reputation to carry out independent tests on their products. Such men are entitled to charge high fees. There are undoubtedly many consulting engineers whose names are not before the public to any extent who are equally capable of organising and conducting tests on all kinds of plant but whose scales of fees are considerably lower than the leaders of the profession. A test conducted by one of these gentlemen under the *ægis* of the Registration Authority would be as convincing as a test carried out by a pre-eminent consultant alone.

The outline of the scheme put forward by Mr. Parsons has much to commend it, but if considered in detail, it is probable that a number of modifications could be suggested. The present is hardly the time to go into details, as such could be discussed by a representative committee appointed to consider the whole subject.

May I suggest that the matter is undoubtedly one which could very well be dealt with by the British Engineering Standards Association. The Mechanical Industry Committee of that Association is as representative a body as can be found anywhere, and although the registration of tests possibly does not lie exactly within the scope of the functions of the Association, yet as the object of registration is to obtain a "British Standard of Accuracy" there would appear to be some justification for referring it to that body.

London, December 18th. W. J. MARSHALL.

B.E.S.A. SPECIFICATIONS.

SWITCHGEAR EQUIPMENTS.

THE British Engineering Standards Association has just issued a companion specification to No. 194, published in 1926, which dealt with switchgear equipment for direct-current circuits. These schedules for three-phase alternating-current circuits have been drawn up with a view to specifying the least amount of apparatus which will control the machine or circuit, and yet avoid fire hazards, discontinuity of supply, and danger to the operator. In many cases, according to the nature of the service, size of plant, and other circumstances, additional apparatus will be required or desired, and to this end the appropriate additions to the various equipments are separately scheduled as "optional extra equipment," from which a selection should be made after consideration of the requirements of the individual case. The necessary apparatus for earthing the neutral point of a three-phase system, either solidly or through a resistor, is scheduled, and certain requirements are laid down regarding the accessibility of switchboards for cleaning and examination. As in the case of B.S. Specification 194, the schedules are accompanied by a series of diagrams illustrating each type of circuit for which standard equipment is specified. Incidentally, these diagrams afford an excellent illustration of the manner in which the British Standard symbols for electrical purposes may be employed on schematic diagrams.

Copies of the specification, No. 195—1929, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Railway and Road Matters.

AUTOMATIC traffic signals are to be erected in Bombay at the junction of Princess-street and Queen's-road.

FOUR people were killed on the evening of December 13th in a collision between a National omnibus and a Metropolitan Tramways Company's tramcar at Enfield.

THE London and North-Eastern Company proposes to widen its Southend line from two to four roads from the junction with the Colchester main line at Shenfield to Mountnessing Siding, a distance of 1·4 miles.

THE Southern Railway placed into service in October last the new steamer "Isle of Jersey," and on Tuesday, the 17th, a sister ship, the "Isle of Guernsey," began running. Both are engaged in the Channel Islands service and have been built by William Denny and Brothers, Ltd.

THE floods, particularly in South Wales, Somerset and South Devon, during the present month have been so serious that we must put upon record that the Great Western West of England expresses *vid* Westbury have, owing to floods at Athelney, had to be diverted to the old route through Bristol.

IN order to build up an efficient staff in every department of the various railway administrations in China, the Ministry of Railways has formulated regulations governing the sending of students to work in various railways in America for periods of two years, so as to acquire practical experience in railway administration.

A WORKMEN'S train from Brussels was derailed at the entrance to Namur Station on the Belgian State Railways on Tuesday, December 10th. Nine passengers and a guard were killed. Press reports since state that it has been admitted that the brakes failed when descending an incline, but as the driver has since been arrested for negligence that may hardly have been so.

ANSWERING a recent question, Mr. J. H. Thomas said that he was aware of the proposal to close the Muir-of-Ord and Fortrose line because the traffic had diminished to such an extent as to be uneconomic. He was not, however, prepared to stipulate for the continuance of uneconomic services as a consideration of a development grant under the Development (Loans, Guarantees and Grants) Act.

IT having been suggested that the London and North-Eastern Company's electrification in the Newcastle area should be extended to the south side of the river Tyne and run to South Shields, Mr. Morrison communicated with that company. According to the reply to a question on the subject, the answer received was that, in the opinion of the railway, there were several other schemes for improvements which should be given precedence.

THE parliamentary proposals of the London, Midland and Scottish Railway include a new line which will give that company access to Victoria Docks and the lines of the Port of London Authority independently of, as now, having to run over the London and North-Eastern. The new railway will leave the Tottenham and Forest Gate Railway at a point east of Woodgrange Park and there will be a connection from off the Tilbury line east of East Ham.

IT seems only quite recently since our Annual Article on Railways recorded some improvements in the Southern Railway station at Exeter. It is now announced that that station is to be reconstructed at a cost of £196,000. We take it that it is the station buildings that are now to be dealt with, as they are decidedly obsolete. The new scheme provides for booking offices, parcels depôt, &c., on the street level. The alterations at track level are the lengthening of the down platform and of the Exmouth bay platforms and the rearrangement of the roads at the western end of the station.

THE recently issued Railway Returns for 1928 show that, at the end of the year there were 23,666 locomotives—steam, electric and petrol—a decrease for the year of 345. There were 51,965 passenger carrying vehicles, which was a drop of 296, but the seating capacity was increased by 16,703 to 2,809,363. The average seating capacity per vehicle rose from 53·44 to 54·06. The above figures refer to passenger vehicles of all kinds; in coaches for steam-worked trains the number fell by 691, but electric motor vehicles increased by 196 and steam or petrol-driven rail motors by 159. The number of merchandise and mineral wagons, owned by railway companies, was 706,081, a decrease of 11,660, and their capacity was 7,674,258 tons, a decrease of 43,268 tons. The average capacity per wagon rose from 10·96 tons to 11·08 tons. The number of wagons, other than special wagons, of a capacity of 20 tons and over was 25,120, as compared with 24,894; of these, 23,644 in 1928 and 23,499 in 1927 were allocated specially to mineral traffic. The stock of Pullman cars advanced from 191 to 204.

THE serious collision of October 12th, 1927, in the Queen-street Tunnel, Glasgow, by which four passengers lost their lives, has once more made manifest the little-known fact that passengers taking tickets, issued at a lower rate than the ordinary fare, forfeit all claims for compensation in the event of an accident on the railway. In view of the fact that about 60 per cent. of the passengers who travel to-day do so at reduced fares—and in this we include week-end tickets—we would point out that the railway time tables and public notices contain an intimation that excursion and other tickets issued at fares less than ordinary fares are subject to the condition that "Neither the holder nor any other person shall have any right of action against the Company . . . in respect of (*a*) injury (fatal or otherwise), loss, damage, or delay, however caused, or (*b*) loss of or damage or delay to property however caused." In giving judgment in such a case arising out of the Queen-street accident, Lord Moncrieff, in the Edinburgh Court of Session, on December 4th, said that it seemed to him merely extravagant to suggest that a carrier could, with such indirectness, under the burden of such laborious discovery, and by a stereotyped intimation which was so uniformly given, claim to have obtained from his passengers a special consent to the discharge of his liabilities in law.

Notes and Memoranda.

SQUARE-MESH wire netting is being used extensively in German coal mines to prevent falls in underground roads. It is claimed to reduce the lodging places for dust and to help in consolidating the framework.

IN the annual report of the Director of the American Bureau of Standards it is stated that, in continuation of the research on seconds signals, the Bureau proposes to construct a pendulum which will give accurate seconds signals by means of a photo-electric cell and to cause the cell at the same time to close a circuit which will give an impulse to the pendulum and maintain its motion. Results so far are encouraging.

IT is claimed for some malleable iron castings used in the railings of the new Liberty Bridge, Pittsburg, that they have a yield point of 17·4 tons and an ultimate strength of 26·3 tons with an elongation of 25·5 per cent. in 2in. Impact tests showed that a wedge-shaped piece 6in. long tapering from ¼in. to 1in. at the base to nothing at the top, would sustain thirty-three blows of 70 foot-pounds each before it was completely curled up into a scroll. There was no cracking.

IN a paper entitled "Tests on Efficiency of Rock Drills" read before the South African Institution of Engineers, the author suggested a reduction in the amount of air used in the return of the piston after its working stroke. His general conclusions are:—(1) That the efficiency of a hammer drill increases uniformly with the pressure of air supply; (2) that the lubricant for a hammer drill, which is essentially a high-speed, cold-working machine, should be as thin as possible, consistent with sufficient surface adhesion; (3) that the "return air" ports of all hammer drills should be given the minimum area which will ensure best rate of working. Automatic adjustment of this area would be a first essential, as the magnitude of it has been found to depend upon the hardness of rock being cut; (4) that it appears possible, from the work already done, that some such automatic cut-off device could be incorporated in drills of the type under consideration without the normal operation of such drills being upset or interfered with in any way.

ONE of the tubes of a water-tube boiler in a factory at Bakewell exploded, and the accident is the subject of a recent official report. It is stated that the boiler had been in continuous operation for five months, and that the tubes were scaled to a thickness of $\frac{1}{16}$in. The explosion was, obviously, caused by overheating. Up to the time of the explosion the feed water was taken from the river Wye and treated in a softening plant before being heated and passed into the boiler. A chemical analysis of the river water before treatment showed the water to be very hard and to contain about 16·07 grains of scale-forming matter per gallon. After treatment the figures were reduced to 3·74 grains per gallon, which was still high enough to ensure a deposit of about half a pound per 1000 gallons of water evaporated, so that with long working periods a considerable amount of deposit might be expected on the water side of the tubes. Since the explosion a turbo-generator has been installed and the steam from the latter passes into a condenser. The addition of the condensate to the treated river water has reduced the hardness figure still further, but even under the new condition more frequent cleaning of the boiler would be advisable. The boiler was twenty-seven years old.

A NEW boron-containing mineral, which has been variously called Razorite or Kernite, is found in the Mojave desert of California, at depths some 600ft. to 800ft. below the present surface of the ground. The pure mineral is colourless, transparent, and occurs in lamellar or columnar form. It contains the oxides of boron and of sodium, together with some water, and in places is of high purity, but differs markedly in physical properties from the ordinary borax of commerce. Its constitution has been of great interest to the chemist, who has hitherto known only the normal crystallised sodium borate, which contains ten molecular proportions of water to one of borate, and the octahedral sodium borate, with five molecular proportions of water. Both of these forms are readily soluble in water, the former being the sort found in Nature as the result of the natural evaporation of alkaline lakes. The octahedral form is unstable with respect to water at ordinary temperatures, and is not found in Nature, but can be prepared in the laboratory by crystallisation above 142 deg. Fah. Chemists have not succeeded in preparing the new mineral form in the laboratory, for although it contains from 3½ to 4 molecular proportions of water, it is dissolved in water only with considerable difficulty. It seems probable that the material is a product of volcanic activity. One of the larger uses for the borate is in the manufacture of certain special glasses and for glazes of sanitary ware.

THE far-reaching consequences of the increased use of machinery in farming in Western Canada were, says *Canada*, pictured by Professor A. E. Ottewell, Registrar of the University of Alberta, in speaking on "The Business of Wheat Growing," before the Montreal Canadian Club. Pointing out how the "industrialisation of agriculture" has been hastened by the advent of the gasolene tractor, he drew attention to what has happened since the appearance of the combine thresher unit on the Western farms in 1925. Last year 4000 of these machines were in operation, harvesting 2,500,000 acres of land and representing an investment on the part of the farmer of 11,000,000 dollars. Professor Ottewell described them as having revolutionised agriculture in the West by cutting in two the number of men necessary for the gathering of the crops, and also cutting in half the cost of operations. Whereas, he said, 100 years ago nine men working on the land could only produce food for themselves and one person, to-day 25 per cent. of the population can produce food for the other 75 per cent., and more than that very easily, and he declared the time to be near when 10 per cent. of the population will be in a position to produce all the food necessary for the nourishment of the 90 per cent. left. This, of course, is a great boon to the farmer; but, as Professor Ottewell emphasised, it must result in a more or less serious social problem, as it means the thinning of the rural population, and looks like resulting in farming becoming a large capital undertaking.

Miscellanea.

THE power plant on the Tusket River, Nova Scotia, has been officially opened.

THE 11,000-volt transmission line from Pykara to Ootacamund, Madras, has been completed.

A TIN-PLATE mill with an annual output of 60,000 tons is to be put up at Ojibway, Ontario.

A FACTORY for the manufacture of petrol railway cars is to be put up in Toronto by an American company.

IT is officially predicted that the output of the mines of Ontario will amount to 110,000,000 dollars this year.

THE President-elect of Mexico, Pascual Ortiz Rubio, is one of the most prominent hydraulic engineers of that country.

TRIPLE-DECK cages, in place of the present double-deckers, are to be installed at No. 1 pit, Tilmanstone Colliery, Kent.

IT is proposed to put up another rubber-reclaiming factory in the Liverpool district. It will work on the alkali process and have an output of 20 tons a week.

THREE new aluminium making plants are being put up in Italy, which will bring the annual production up to 8000 tons. This should leave some 3000 tons for export.

THE Punjab Government has, according to *Indian Engineering*, decided that the material for the towers of power transmission lines may be imported free of [illegible]

IT is announced that a plant for the demonstration of the Musso semi-direct steel process is to be installed in the pyrometallurgical laboratory of the Canadian Department of Mines.

AEROPLANE journeys totalling 22,000 miles were made during the field season of 1929 by officers of the Geodetic Survey of Canada, Department of the Interior, in the performance of their duties.

CLASSES of instruction in various branches of engineering for women will begin at the Borough Polytechnic Institute in January next year by arrangement with the Women's Engineering Society, of 46, Kensington-court, London, W. 8.

AS a result of the considerable and growing increase in patent applications and correspondence, the Board of Trade has increased the examining staff of the Patent Office, which now numbers 285. Arrangements are being made for a further increase and the office is being reorganised.

A LARGE deposit of china clay has been discovered on a gold-mining claim in the Michipicoten area of Algoma district of Northern Ontario. The deposit covers an area of about 5 acres and analysis shows it to be of good commercial grade. Negotiations are in progress towards the development of the deposit.

THE Ontario farmer is awakening very rapidly to the manifold uses of electricity on the farm. This year the Ontario Hydro-Electric Commission has already constructed 1157 miles of rural electric lines to serve the needs of about 6700 consumers. This construction was in addition to the 4000 miles already in operation. The cost of the new lines is estimated at approximately 2,650,000 dollars.

ADVANCE information about exhibits to be shown at the British Industries Fair at Castle Bromwich, from February 17th to 28th, 1930, reveals that nearly 600 exhibitors at least will have one or more articles on show for the first time. These include improved metal-clad switchgear, driving belts, visible weighers, windings, electric arc welders, electric furnaces, plant for the handling of materials, gas governors, and gas switches.

THE latest return by the National Federation of Iron and Steel Manufacturers shows that the number of furnaces in blast at the end of November was 163, a decrease of three since the beginning of the month. The production of pig iron in November amounted to 631,400 tons, compared with 688,700 tons in October and 544,400 tons in November, 1928. The production includes 179,100 tons of hematite, 279,900 tons of basic, 126,100 tons of foundry, and 23,800 tons of forge pig iron. The November output of steel ingots and castings amounted to 815,000 tons, compared with 889,800 tons in October and 762,500 tons in November, 1928.

SPEAKING at the annual dinner of the Imperial College of Science and Technology, on Monday, December 9th, at the Hotel Victoria, Professor W. W. Watts, in proposing the toast of the guests, drew attention to the fact that the College was living through a difficult period, the new statutes of London University presenting problems which they were loyally trying to solve. The statutes appeared to confirm certain privileges which had already been granted to the students and the examinations of the College, but they seemed to close the door to other ambitious schemes which had occupied the thoughts and labour of several members of the College. He felt that the special position of the College, originated and for many years carried on by the Government as the first experiment in the application of education in science to industry in the country, had not been sufficiently considered.

IT is reported from Constantinople that a company with the title "Baschtasch Turk Maaden Schirketi," and with a fully paid capital of £T200,000, has been formed for the exploitation of the Turkish chrome ore deposits. Of this capital, £T179,000 are held by the A. B. Basshuf, of Stockholm—which has been formed by eight of the largest Swedish steel works for the purpose of securing their chrome ore requirements—and £T20,000 of the capital is held by Ohran Brandt, who is the agent for the A. B. Basshuf in Turkey, and also the concessionnaire for a number of further chrome deposits. The new company is, says the *Chemical Trade Journal*, empowered to export 16,000 tons of chrome ore a year. During the war this trade was in the hands of Krupps, but it stopped by Government decree. It is also reported that engineers of the London Chrome Company (?) and of the Société des Forges Françaises have been busy in Turkey recently trying to acquire concessions for chrome ore areas which are still on the market.

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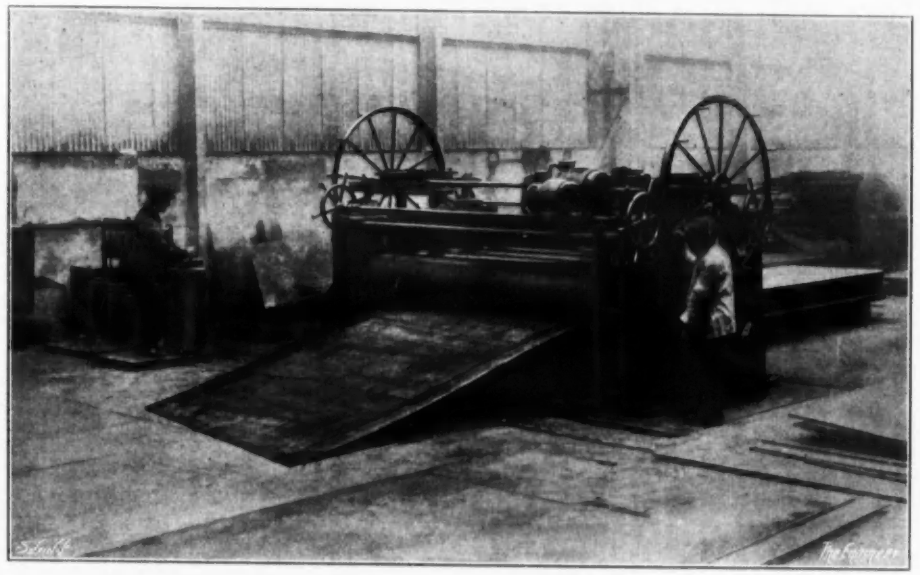

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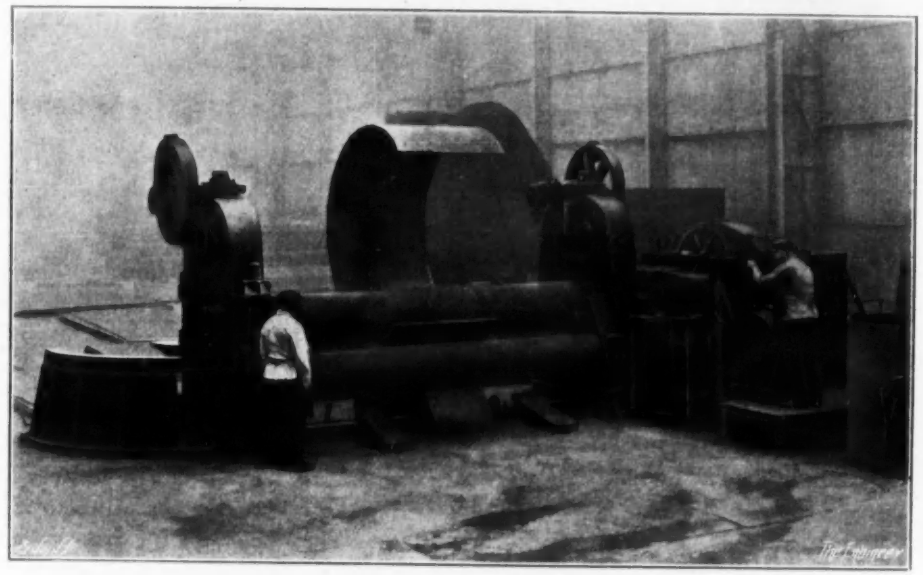

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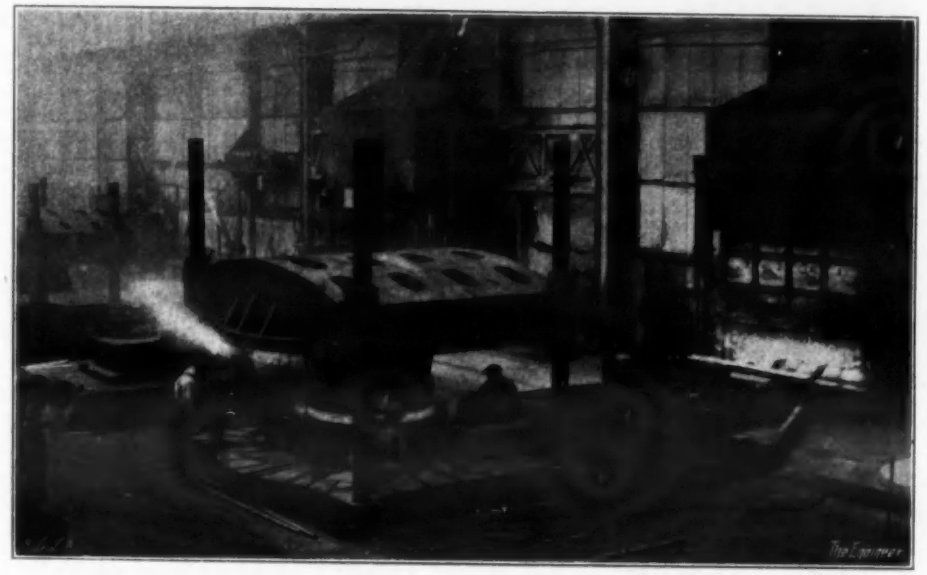

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DEATH.

On December 14th, at Cranfield, East Grinstead, LOUIS PENNY, M. Inst. C.E., in his 88th year.

THE ENGINEER.

DECEMBER 20, 1929.

Street Noises.

WE are firmly persuaded of the ability of engineers to do anything that science permits—even though at first it may not seem to be within reason. But pressure must be applied to them. Like all men, in all vocations, they tend to follow the line of least resistance, and unless they are compelled by laws or regulations, or by the competition of those who are more enterprising, to get rid of evils or nuisances, they will let them remain. Distasteful to them as the regulations against the emission of black smoke were at first, and still are, they have found means of removing, or at least greatly mitigating, the offence, and in so doing have actually improved the operating efficiency of steam boilers. In course of time, we may see regulations against the ejection of fine dust and poisonous fumes from chimneys turned from an expense into a benefit. The removal of ash, dirt, and impurities from coal before firing is certain to increase the efficiency of boilers, and may not improbably augment the economy when the cost of such preparation of the fuel is reduced by the invention of improved methods. But in any case, whether it costs more or not, the world is beginning to see that we cannot measure economy only by its immediate visible results. We may imagine a power station operated free from all restrictions of any kind for nuisance, and attaining, in consequence, an exceptionally high economy. But the secondary effects—let us say, on local agriculture, buildings, the health of the neighbourhood, prevalence of fogs, and so on—might, in fact, when measured on the scale of total good, be deplorably bad. The time has come when the narrow view must go. No man must be able to say, "I can save money by neglecting these things," unless he can show at the same time that he is in no way damaging the efficiency and welfare of others, and putting them, in consequence, to expense. Nothing is gained by the community as a whole if the expenditure saved by one has to be borne by others.

In one of our Journal notes to-day we refer to a protest that is being made against the racket that is set up by pneumatic road breakers employed by contractors to the Westminster City Council. The Works Committee of the Council has made a report upon the matter, but holds out little hope of immediate redress. We note, however, that it does regard the question as "one that should be taken up in the public interest." That is a sign of grace. But when the Committee tried to get something done, it was met with a *non-possumus* at every turn. The Department of Scientific and Industrial Research refused to have anything to do with it, on the grounds, apparently, that "the noise of the drills may present a financial rather than a scientific difficulty"; the contractors stated that the use of silencers would involve the use of more compressors, and that "they have not found any justification for the claim of silent compressors or hammers"; the City Engineer claims that the saving of time effected by the drills justifies their use. Now, these are all excuses for something that is admittedly bad. If it be true that silencers reduce the efficiency of the drills by twenty-five per cent., then it is clear that the best kind of silencer has not been invented; if it be true that the difficulty is "a financial rather than a scientific one," then it is plain that, in the opinion of the Department of Scientific and Industrial Research, there is no scientific reason why the nuisance cannot be abated; if it be true that "justification for the claims of silent compressors and hammers" is lacking, then manifestly there is room for improvement. Every one of the excuses is an indictment of the engineer; he has not yet done what he ought to have done, produce a device—possibly not a percussive hammer at all—which will break the roads up quickly, efficiently, and cheaply, but without noise. As long as the present appliances are tolerated, they will continue. It is only by ceaselessly protesting against them, even by making the contractor who uses them liable for "nuisance," that we shall get rid of them. Already one or two attempts have been made to silence the exhaust of the hammer, but we have not yet seen any effort made to silence the compressor unit as a whole. It works as a rule under a cover which makes an excellent soundboard, and is left open at the sides. If it were completely boxed in with sound-proof material, and mounted on adequate cushioning devices, there can be little or no doubt that the noise it produces could be reduced to almost negligible proportions. But whether that means or some other means be the best, we are convinced that engineers, if they are put to it, can remove entirely or very greatly diminish the nuisance.

It is not the way of engineers to say "It can't be cured and must be endured." They will not admit that anything within the bounds of mechanism and the laws of nature is impossible. The only reason for not doing anything is that it is not worth doing or that it costs too much. There can no longer be any question that the reduction of street noises is something worth doing; it is becoming imperative that it should be done. That it costs more to work silently than noisily may be true, but, in the first place, the difference in cost may be well worth while, and, in the second, it is the business of engineers to see that the augmentation of cost is not excessive. We implore them to recognise and admit that anything which they do which is a nuisance to the public is a disgrace to their profession.

Modern Transformers.

THE "Grid" contracts that are being placed with British electrical manufacturers are giving rise to the production of electrical apparatus for very high voltage and large output, and valuable experience is being gained. In the design of transformers for the scheme much ingenuity has been displayed, particularly in connection with the on-load tap-changing equipment, which is one of the special features of these units. While an ordinary transformer is a perfectly simple and straightforward piece of apparatus, those that are fitted with this gear are naturally more complicated, and in some cases the design calls for a very fair degree of mechanical skill. No longer is the design of all transformers solely an electrical man's job. The various on-load tap-changing equipments employed by British manufacturers have recently been described in THE ENGINEER, and it will be remembered that as far as the electrical arrangements are concerned, there are, broadly, two distinct schemes—the split parallel winding method and the single-winding method, involving the use of a reactor tapped at the mid point. Another scheme involves the employment of a variable ratio auto-transformer, constructed

on similar lines to an induction regulator, which is inserted between two adjacent tappings of the main transformer, so that a gradual change in the voltage is brought about without interrupting the circuit. The tapped reactor method is, however, most commonly adopted by British manufacturers, who, under the Central Electricity Board contracts, have been given a free hand. There were no restrictions on manufacturers regarding the methods of obtaining the regulation other than the requirement that no phase displacement should be produced, and each firm has therefore worked in accordance with its own ideas.

All the designs appear to operate satisfactorily; at any rate, we have not heard anything to the contrary, which speaks well for the skill that has been brought to bear upon the problem. The system of on-load tap changing, it is to be remembered, is more or less new in this country, although in America it has been in use for some little time. At the end of 1928 it was reported that about 25 per cent. of the kVA of all the American General Electric Company's transformers and nearly 40 per cent. of all the company's transformers above 20,000 kVA were provided with on-load tap-changing gear, and that over 2,000,000 kVA of transformers so equipped were in service. Apart from the tap-changing gear, the large "grid" transformers have presented other new problems to designers. The question of transport, for instance, has called for very careful consideration, for while there is no difficulty in building transformers for any output, the task of getting them to their destination is not so simple as it might appear. But by making certain parts detachable, and with the aid of special trucks, it is now possible to transport by rail and under ordinary traffic conditions three-phase 132-kV transformers with an output of 75,000 kVA, and weighing about 98 tons. The difficulties in the direction of keeping down the height can be minimised by the five-limb core type construction. Another interesting feature of these large grid outdoor transformers is the method of cooling. Under normal operating conditions, a "grid" sub-station will employ two transformers in parallel carrying between them the full load of the line and will operate with natural cooling. In those conditions each transformer will carry only half the load, but in the event of emergency or the load rising above normal, auxiliary air blast cooling will be automatically brought into operation. The method of measuring the voltage on the high-tension side of these transformers also is distinctly ingenious, for by connecting voltage transformers to the low-tension side of the main winding and by providing means for compensating errors due to the main transformer regulation, the use of separate super-voltage transformers for measuring purposes is avoided. These 132-kV "grid" transformers represent the most recent developments in transformer practice, and, as indicated, are notable in several respects. They indicate how rapidly British manufacturers can grapple with new problems that arise. Manufacturers are also devoting attention to the construction of transformers with more than two windings. Extra windings were provided in the past in isolated cases in the form of an additional secondary to feed a separate load, as, for instance, where lighting and power circuits must be kept separate. The introduction of a third or tertiary winding in power transformers, however, is now mainly due to the requirements arising out of the progress and growth of electrical power transmission, especially in the interconnection of networks and the interlinking of supply systems. In some places the increasing use of tertiary windings has been brought about by the introduction of synchronous or static condensers to improve the regulation and power factor of overhead high-tension transmission lines, the condenser being connected to the tertiary winding in the main step-up or step-down transformer. Transformers are also fitted with tertiary windings in order to link together three networks or supply systems, so that power can be interchanged between them. Apart, however, from supplying an additional load or acting as an additional primary winding, the tertiary winding has a very real use in three-phase systems to eliminate the inherent disadvantages of star-star connected transformers which have no internally closed electrical path within the transformer and around which certain balancing or stabilising currents can flow. By providing an additional auxiliary winding connected in delta, however, a closed path is provided for the circulation of these currents and the chief disadvantage of the star-star connection are removed. The various functions of tertiary windings in power transformers are very ably set forth by Mr. E. T. Norris, in a publication issued by Ferranti, Ltd., a firm that is always well to the fore in transformer developments. The calculation of the technical performance of three winding transformers when each winding carries an appreciable load is considerably more involved than for a normal two winding, but practical methods have been developed whereby the regulation characteristics can be determined.

Up to the present the demand for these special transformers seems to come mainly from abroad, where very large units with as many as four windings are in operation. Transformers with more than two windings are, however, turned out by British firms which have nothing to learn concerning transformer construction from continental and American companies. Never has the demand for transformers been greater in this country than it is at the present time, and never have more interesting types been produced. As the result of long experience, study and research, modern transformers leave little to be desired. The efficiency of large units is now so high that there is little room for improvement. Similarly in the matter of reliability, the modern transformer, if properly protected, is highly satisfactory, and few things associated with electric supply systems require less attention or cost less to maintain.

Institution of Mechanical Engineers.

BEARINGS FOR LINE SHAFTING.

ON Friday of last week Mr. F. Wigglesworth presented, before the Institution of Mechanical Engineers, a paper on "Bearings for Line Shafting," which had been prepared by Professor G. F. Charnock shortly before his death on November 7th, 1929. The first part of the paper appears elsewhere in our present issue, and it will be followed by the second half in a subsequent issue.

In the unavoidable absence of the President, the chair was taken by Mr. Loughnan Pendred, President-Nominate. In introducing Mr. Wigglesworth, Mr. Pendred said that he believed that it was the first occasion in which a paper had been written and the author had died before he had been able to present it. It was most fortunate, he thought, that the late Professor's friend, Mr. F. Wigglesworth, who had in part been responsible for some of the work that had been carried out, should have consented to present the paper. The Chairman then announced that he intended to adopt a new method with regard to the discussion of the paper, and he requested all those who wished to take part to send up their names immediately after Mr. Wigglesworth had ceased speaking. This being done, the time available was then allotted to the various speakers.

Mr. F. Wigglesworth, in presenting the paper, made reference to his forty-four years of friendship with Professor Charnock and the essentially practical manner in which the subject had been treated. From personal experience he had found that when taking friction diagrams from line shafting it was very difficult to obtain consistent results. When all the belts had been removed the conditions were not those in service and higher coefficients of friction than those under service conditions were often obtained. As an instance of modern practice with well-designed ring lubricated bearings he gave two examples. One was that of a spinning mill in which 160ft. of line shafting, varying in diameter from 4in. to 3in. at the tail end, transmitted, by means of fifteen 1in. ropes, 200 H.P. at 300 r.p.m. When the power was cut off this shafting ran for two minutes before coming to a standstill. Again, in the case of a 84 B.H.P. suction gas engine drive for a weaving shed, in which fourteen lines of 3in. diameter shafting, each 90ft. long, totalling 1260ft., were employed, running at a speed of 140 r.p.m., only 9 H.P., or 7 per cent. of the total, was needed to drive the shafting alone. He agreed that the improved roller type of bearing was very suitable for heavy duties.

In moving a vote of thanks to Mr. Wigglesworth, Mr. Pendred said that the paper combined both theory and practice. Professor Charnock was essentially a practical engineer and had always taken the deepest interest in the use of mechanism of every kind. It was no secret that he had left behind over 10,000 lantern slides which he had used when lecturing on various branches of mechanical engineering. The man himself stood out in the way in which he had dealt in the paper with the problem of line shafting, and Mr. Pendred suggested that a letter should be sent to the family of Professor Charnock, stating how gratified the members of the Institution were to receive such a paper. Mr. Wigglesworth also deserved thanks for the evident care he had taken in summarising and presenting the paper.

Mr. H. S. Rowell, who was called upon to open the discussion, said that in July last Professor Charnock had asked him about the earlier part of the paper dealing with the work of Sommerfeld and Gümbel, which part of the paper, he believed, was the first account in England of the work of these authors. In October last he agreed to take part in the discussion. Mr. Rowell then proceeded to give a short chronological account of the development of the theory of friction from 1699 up to the present, passing in review the work of Beauchamp Tower, Petroff and Osborne Reynolds, and the later development of the theory by Sommerfeld, Gümbel, Stanton and Professor Goodman. The simplified mathematical treatment of the problem by Gümbel had shown, he pointed out, that the attitude curve of the journal was, as given by Professor Charnock, approximately a semi-circle. The reference in the paper to the experimental determination of the most suitable oil clearance for any given case was borne out in motor car work, in which it was usual to fix the tolerances by experience and later adjustments. The question of temperature was important, for the viscosity of the lubricant altered quickly with changes of temperature. A variation of 25 deg. corresponded to a fourfold change in viscosity.

Mr. C. H. Smith, of the Hoffmann Manufacturing Company, Ltd., spoke as an anti-friction bearing engineer, and dealt with the matters of first cost and replacement. He considered it good policy to use roller bearings, and suggested that the only points in favour of a plain bearing were its lower first cost and the fact that it was more easily replaced. Some of the differences in cost between such bearings and anti-friction bearings disappeared, however, when the higher running speeds with the correspondingly smaller and cheaper motors which could be used with roller bearings were taken into account. For new installations there was no need for increased cost, either with ball or roller type bearings. It might be true that roller bearings were more difficult to replace, but they were not, he held, more difficult to mount originally. With present design the bearing could be slid along the shaft and only needed to be clamped up. With regard to the replacement of such bearings, his firm had received only thirty-five complaints in 30,000 bearings supplied. These complaints covered cases in which there had been no fault in the bearings themselves, and even then the percentage of complaints was only about one-tenth of one per cent. As to maintaining the bearings, it was only necessary to tighten the clamping nut, and to check its tightness after a few weeks, and no further attention was needed for six to twelve months. A ball bearing could not seize and there was no danger, he suggested, in running the shaft with a broken bearing until the end of the shift, when replacement could be effected.

With regard to power saving and the tests carried out in the machine referred to in the paper, it was a pity, he thought, that some coefficients of friction were not given in order to enable direct comparisons between plain and anti-friction bearings to be made. The friction loss of a good plain bearing compared with that of a ball bearing had been given as 4 : 3, but if account had been taken of the 0·0015 coefficient of friction for self-aligning ball bearings that relation would have been nearer 8 : 3. Whilst power saving in bearings was important, it did not always mean that with efficient bearings the total power bill was reduced, for the question of windage and other factors, such as belts, had also to be taken into account. In an experiment made by his firm with 144ft. of 2½in. shafting driven with a 12in. belt, 2·5 B.H.P. was found necessary to run the shafting light, whereas with the belts off the shafting could be pulled round by hand. When a 2in. belt was put on the power required was reduced to 1 B.H.P., it being found that the power required to bend the 12in. belt was more than the friction loss in the shafting.

Mr. F. Carnegie (Woolwich) spoke as a user of various types of bearings. He said that while he had found ring lubricated bearings to be generally satisfactory, they required attention and cleaning, with correspondingly high maintenance costs. Better and more economical results had been obtained with ball bearings. As compared with plain bearings, there was a saving of from 20 to 30 per cent. in starting torque when ball bearings were used, and when power cost was determined by a maximum demand system, such a saving had an important influence on the higher first cost. He thought that there was a saving of about 33 per cent. in running costs, while with regard to maintenance costs ball bearings showed considerable advantages, especially with tight belts. He recalled a case in which, with the exception of oiling, say, once a year, shafting fitted with ball bearings twenty years ago had run throughout the war period, and was as good to-day as when first put in. There was certainly a saving in attention and the oil used, and there was no need to oil the shafts after the machines were shut down. His own experience showed that such bearings were reliable, and there had been no breakdowns. Under such conditions, the difficulties of replacement disappeared. Ball bearings were particularly advantageous for countershaft work, and he now specified them for all such shafts and for loose pulleys. He attributed freedom from trouble to excellence of the materials and the workmanship in ball bearings of reputable British make. It paid to replace existing plain bearings with ball bearings, as very definite economies could be shown.

Mr. E. R. Dolby referred to the attitude of the journal bearing and recalled his question in the dis-

cussion of Mr. Hodgkinson's paper on the arc of contact, which had not yet been answered. He thought that the author's reference to the attitude of the bearing should read: "The attitude of the journal in the bearing." He further noted that it was suggested that the arc of contact of the bearing surface should be reduced to 110 deg., and asked if this allowed for the attitude of the journal when rotating in either direction. Could, he asked, a general opinion be given that the arc of contact of 110 deg. could be accepted and that clearance could be provided beyond it? In the matter of lubrication, Mr. Dolby recalled some experiments with a bearing which was provided with a dry graphite lubricant contained in ¼in. holes drilled in the bearing surface. Had there been any progress made, he asked, in the direction of producing a bearing which would run when dry?

Mr. Sidney Kay, who spoke on behalf of the Cooper Roller Bearings Company, Ltd., said that he disagreed with the author's views on the use of split roller bearings with the cages made in halves. The fact that over 100,000 such bearings, some of them as large as 28in. diameter, had been fitted and had run successfully for over eighteen years dispelled any doubts as to reliability. Some large split roller bearings for wet and dry grinding mills in cement works were illustrated, and the speaker referred to two such bearings running at 1750 r.p.m. on a disintegrator, and to others running at speeds of 4000 to 4600 r.p.m.

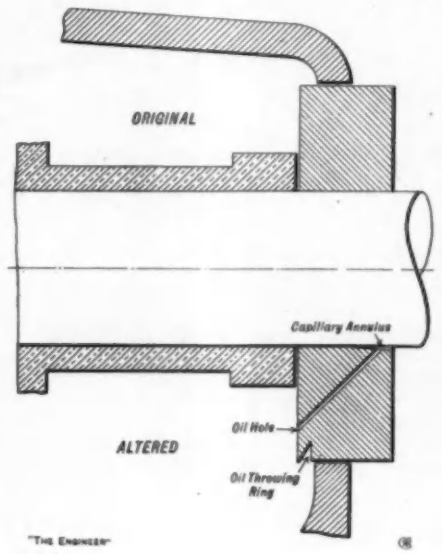
Professor W. E. Dalby agreed that the author's reference to the attitude of the bearing should read the attitude of the journal in the bearing. The paper was, he thought, an excellent review of the theory of lubrication and with special reference to line shafting in mills. As far as he could see, the plain bearing was only preferable on the ground that it was quickly replaceable. In an experiment made on the shafting installed in a technical college, he had found that 65 to 67 per cent. of the power was being absorbed in shafting and bevel gearing of old design, whereas in a new workshop with well-balanced belt drives and ball bearings the shafting had run successfully under increasing loads since 1911, and with no maintenance costs. The Institution was to be congratulated on its 1884 friction experiments, which had formed the basis of all later work on lubrication. It was interesting, he thought, that the Michell bearing was in its origin to be found in Osborne Reynold's paper. As regards the theoretical calculations, there was a difficulty in integrating some of the results, and Professor Perry's simplified calculation, involving a small assumption, was useful. The relation $\frac{d+l}{l}$ given in the paper was also an assumption, and he agreed with the author that the method referred to was subject to defects and that the relation must not be carried too far. In passing, he would draw attention to the fact that one of the best examples of a plain bearing was a locomotive axle-box to which, as far as he knew, no roller or ball bearing had been applied. On the other hand, it was interesting to remember that there was hardly a single plain bearing in a motor car.

Mr. J. D. Twinberrow took up the question of the locomotive axle bearing referred to by the previous speaker, and described the fluctuating conditions met with in such a bearing. It would be useful to investigate the formation of the oil film within such a bearing in which the journal was brought up, first on one side and then on the other. Similar problems were met with in coupling-rods and jack shafts in electric locomotives. In locomotive bearings, the surface was often cut with oil grooves in regions of high pressure, and he would welcome some further knowledge as to the behaviour of bearings under reciprocating loads.

Mr. J. R. Hopper compared some of the methods employed on the Continent and in Russia with Lancashire practice and referred to the use of locating bearings. In some arrangements it was difficult to find room for locating bearings and expansion couplings, and in any case they added to the cost. In flour mill practice long cast iron bearings were not employed, owing to lack of space, and short automatically-lubricated bearings with gun-metal keeps were generally used.

Mr. R. H. Stotesbury also spoke on the practical aspect of the question and confirmed a previous speaker's opinion with regard to the satisfactory employment of split roller bearings. He was sorry that the author had not mentioned this type of bearing, as it was particularly useful for fitting up old factories. In that connection he recalled a mill drive of 500 to 600 H.P., with fifteen 1¾in. ropes, on a 9ft. 6in. diameter pulley weighing from 4 to 5 tons. For this drive two 7in. "Cooper" bearings had replaced two 23in. forced lubrication bearings, which previously had always given trouble by overheating. The split type of roller bearing was particularly easy to apply to existing shafting, and he wondered why the author had overlooked a type of bearing which had been in use since 1912.

Mr. William Taylor said that nearly forty years ago he had visited America and had brought back the Brown and Sharpe self-oiling bearing. He had experienced difficulty with the oil escaping from the bearing by filling the capillary space between the end of the shell and the positioning collar and creeping along the shaft. This oil waste was prevented by cutting an oil thrower ring on the inner edge of the collar, so that the oil was thrown within the bearing casing, and by slightly enlarging the bore of the collar on its outer edge and drilling oblique oil holes from the capillary space thus formed between the collar and the shaft to the inside surface of the collar, thus feeding the oil-throwing ring with any escaping oil—see sketch. At the time he introduced the American type of self-oiling bearing, technical schools in this country were ignorant of the existence of such bearings, and remained so for twenty years. Professor Charnock, if he might say so, was one of the few professors who combined theoretical knowledge with practical experience, and he had thrown new and valuable light on the question of the common bearing. Mr. Taylor suggested that standardised practice in the arrangement of locating bearings would be useful to engineering firms. In stating that in a ring-oiled bearing the ring moved slower owing to the



resistance of the lubricant, the author had, he thought, overlooked that the ring was larger than the shaft.

Mr. L. A. Legros said that there were line shafts other than those in factories, namely, the shafts used in motor cars, and those in the steam turbine, as employed for ship propulsion. In the case of his own motor car, he had fitted forced lubrication at a pressure of 20 lb. to 40 lb. per square inch, and when one considered that a car would run some 60,000 to 80,000 miles with shafts running at anything up to 2000 r.p.m., it was obvious that the shaft would outlast the car. With regard to turbines and marine engines, he handed to the Chairman copies of papers given by Monsieur H. Brillié on oil films and bearings and the basin system of lubrication. These included papers read before the Association Technique Maritime and the Institution of Naval Architects.*

Colonel Kitson Clark made a short reference to the difficulty of applying forced lubrication to the locomotive driving axle bearing, and stated that he had applied the "Brillié" system on a recent locomotive.

Mr. F. Wigglesworth, in the course of a very brief reply, touched only on some of the points which had been raised. In spite of what some of the speakers had said, he stated that he had not found the mounting of bearings of the ball or roller type easy, and he had also known instances when it had been necessary to stop for a broken ball bearing. With regard to tests on ball bearings on the machine described in the paper, a Hoffmann type bearing was now again under test. In 1902 the best coefficient of friction obtained for a ball bearing was 0·0029 and an average figure was 0·0036. He did not think that there was any advantage in the running of a ball bearing compared with a good bearing of the ring lubricated type. With regard to the "Cooper" pattern of split roller bearing, he had installed 7in. bearings of this type in 1902, and he did not know why Professor Charnock had not said more about them. As to double-row, self-aligning ball bearings, these he found had given rise to vibration when tested on the machine and seemed to lack stability. For the taking of frictional load diagrams on line shafts, it was advantageous to be able to cut off the power by a clutch, as in the installation described in his opening remarks, and with such means more accurate results could be obtained. Some twenty years ago bearings were larger in their proportions, and it was to be regretted that commercial competition had tended to cut down sizes to almost the breaking point. When a larger factor of safety had been allowed, there was no trouble, but where sizes had been cut down, trouble had been experienced and renewals made necessary. With regard to the 23in. long forced lubrication bearings which had been replaced by "Cooper" split roller bearings, that was an example of the difficulty experienced in keeping long bearings cool.

* See THE ENGINEER, October 11th, 1929.

SIXTY YEARS AGO.

IN our issue of December 17th, 1869, we reprinted a paper by Mr. Vaughan Pendred, "On Apparatus for Measuring the Velocity of Ships," which he had presented before the Society of Engineers. Mr. Pendred, a few years previously, had succeeded Zerah Colburn as editor of this journal. The subject of his paper is one which to-day excites as much interest as it did sixty years ago and of which the passage of time has certainly not diminished the importance. It is curious to note how little progress has been made with it and how similar are the present usual means of measuring a ship's speed with those which were fully developed in 1869. It is true that in those days the common log was still the most general speed measuring device in use on ships. It consisted, as some readers may like to be informed precisely, of a weighted sector of wood, 5in. or 6in. long and ¼in. thick, designed to swim upright in the water with the apex at the surface. It was attached at the apex to a cord. A second cord was secured to a wooden peg in the log. The two cords were joined to the log line. When the log was pulled in the second cord drew out the peg and the log floated flat or nearly so. The log line was marked by a piece of white bunting 10 to 20 fathoms from the log. When this mark passed over the quarter a half-minute glass was turned. Beyond the white bunting the line was knotted at regular intervals. The speed of the ship in nautical miles an hour was equal to the number of knots passed overboard in half a minute. Theoretically the distance between the knots on the line should have been the one hundred and twentieth part of a nautical mile—6080ft.—or 50ft. 7⅔in. In practice it was 47ft., the reduction being made in order to compensate for errors produced by the "coming home" of the log. The common log was known in 1623 and had remained practically unchanged in form ever since its introduction. Saumerez in 1725 was the first to describe a log fitted with a vane, the rotations of which were counted to give the speed of the ship. Smeaton, Gower and others also experimented with this idea. In 1834 Massey produced his first screw log, the earliest device to compete successfully with the common log. The same inventor introduced improvements in 1836, 1844 and 1848. Walker's harpoon log was closely similar to one of Massey's forms. In Friend's log a paddle wheel was substituted for the screw. No great reliance was placed on any of these logs and sixty years ago shipowners still favoured the common log. Mr. Pendred concluded his paper with a description of the "perpetual" log patented in 1849 by the Rev. E. L. Berthon. This log he described as "perfect in theory and practice." It consisted of a double U tube, the two open ends of which were connected to a Peto (*sic*) tube passing through the ship's bottom at the centre line of the keel. The height to which the water rose in the U tube was taken as a measure of the ship's speed.

BOOKS RECEIVED.

Highway Curves. By H. C. Ives, C.E. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

Whitaker's Almanac, 1930. By Joseph Whitaker. London: J. Whitaker and Sons, Ltd., 12, Warwick-lane, E.C. 4. Price 6s. net.

Stresses Statically Determined. By J. C. Tracy, C.E. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 30s. net.

Port Facilities of Great Britain. London: The Chamber of Shipping of the United Kingdom, 28, St. Mary Axe, E.C. 3. Price 5s. net.

The South American Handbook, 1930. London: Trade and Travel Publications, Ltd., 14, Leadenhall-street, E.C. 3. Price 2s. 6d. net.

Gemischvorwärmung bei kraftfahrzeugmotoren. By G. Becker. Berlin: M. Krayn, Genthinerstrasse 39, W. 10, Germany. Price 5 marks.

Report of the Building Research Board for the Year 1929. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

A History of Mechanical Inventions. By A. P. Usher. London: McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 25s. net.

Seven Place Natural Trigonometrical Functions. By H. C. Ives, C.E. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 12s. 6d. net.

How to Appeal Against Your Rates in the Metropolis. By G. F. Emery. Sixth edition. London: Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 5s. net.

Manual of Electric Undertakings and Directory of Officials. Vol. XXXII., 1928–29. Edited by F. C. Garrett. London: The Electrical Press, Ltd., 13, Fisher-street, W.C. 1. Price 35s. net.

Jane's Fighting Ships, 1929. Edited by O. Parkes, O.B.E., &c., and F. E. McMurtie, A.I.N.A. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price £2 2s. net.

Foundry Practice: A Text-book for Executives, Molders, Students and Apprentices. Fourth edition. By R. H. Palmer. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

Gmelins Handbuch der Anorganischen Chemie. Eighth edition. System No. 57, Eisen. Part A, Leiferung 2; Part B, Leiferung 1. Berlin: Verlag Chemie G.m.b.H. West 10, Germany. Prices: Part A, 13·50 marks; Part B, 46 marks.

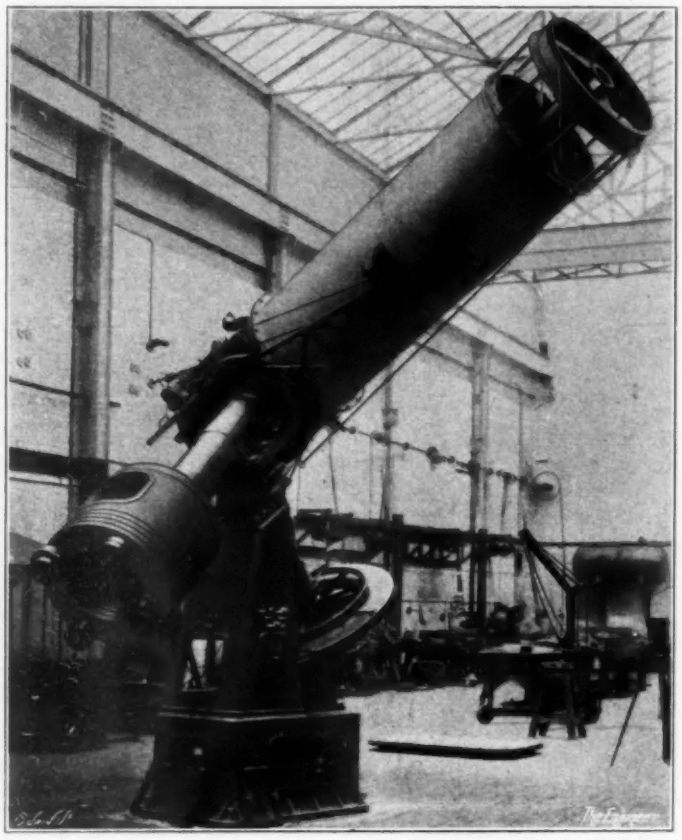
Wasserkraftanlagen. Part I.: Allgemeines und Stauwerke. Part II.: Werkwasserleitungen und Entwurfsgrundlagen. By Dr. Ing. Felix Bundschu. Berlin: Walter de Gruyter and Co., Genthinerstr. 38, Germany. Price 1·50 marks.

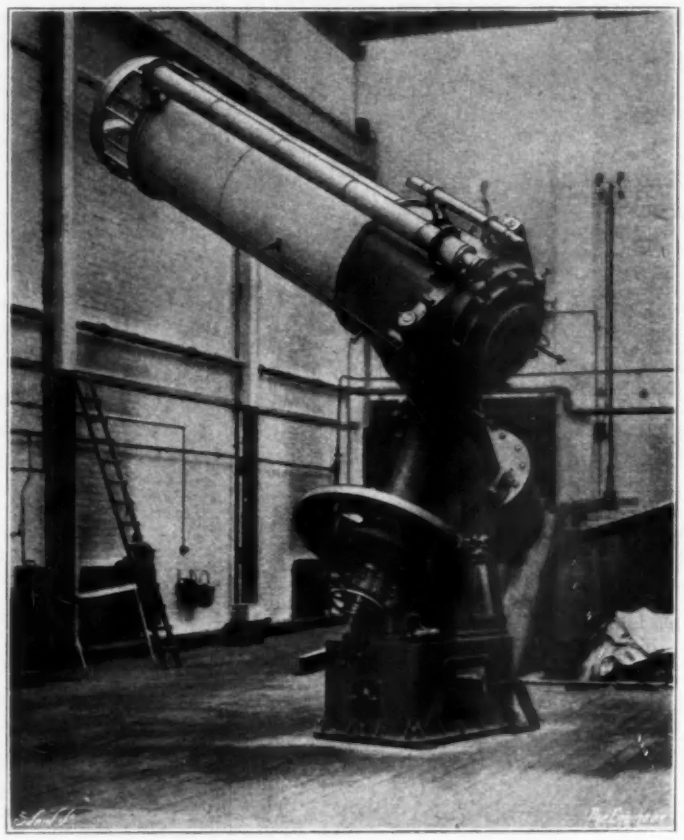
Theory and Practice of Modern Framed Structures. Part II.: Statically Indeterminate Structures and Secondary Stresses. Tenth edition. By the late J. B. Johnson, C.E., C. W. Bryan, C.E., M.A., and F. E. Turneaure, Dr.Eng. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

REFLECTING TELESCOPE FOR EDINBURGH OBSERVATORY

SIR HOWARD GRUBB, PARSONS AND CO., NEWCASTLE-ON-TYNE, MAKERS

(For description see opposite page.)





FIGS. 1 AND 2—THE TELESCOPE IN THE MAKERS' WORKS

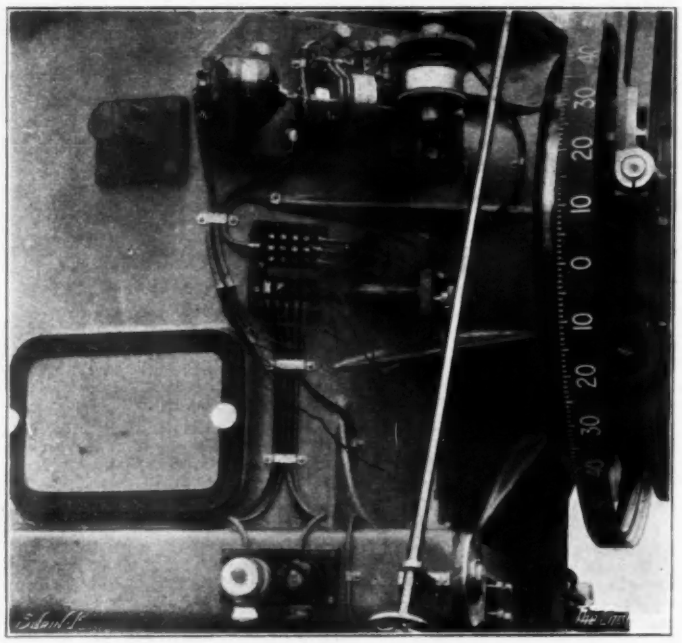


FIG. 3—BREECH END OF TELESCOPE TUBE

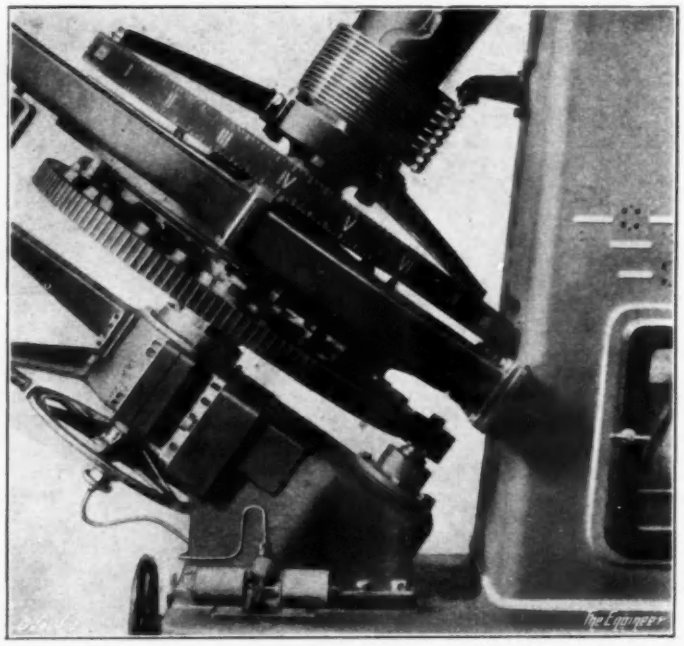


FIG. 4—LOWER END OF POLAR AXIS

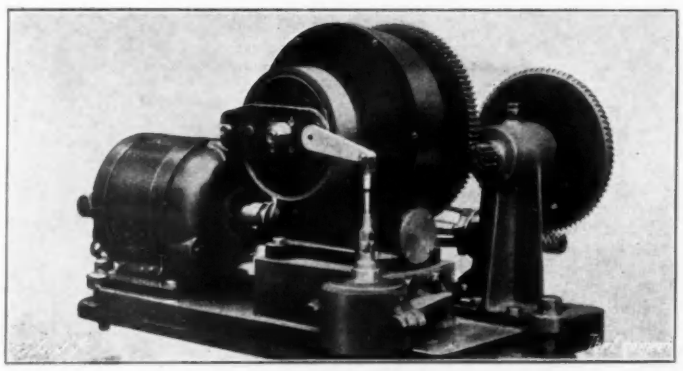


FIG. 5—RIGHT ASCENSION QUICK MOTION GEAR

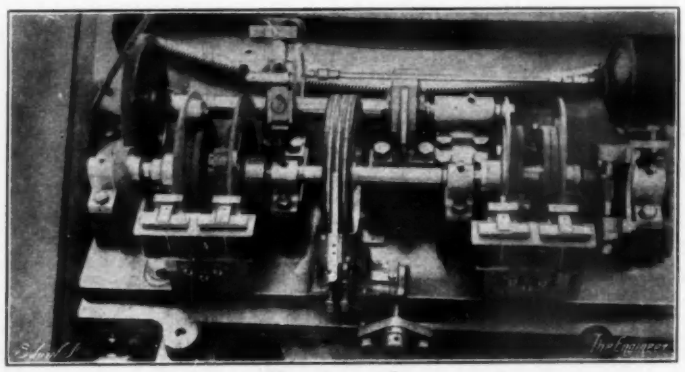


FIG. 6—GEAR PLATE AND CONTROLLING MECHANISM

36in. Aperture Reflecting Telescope for Edinburgh Observatory.

IN our issue of June 7th we made brief reference to the new 36in. reflecting telescope for the Royal Observatory at Edinburgh, which was exhibited on the stand of C. A. Parsons and Co., Ltd., at the North-East Coast Exhibition at Newcastle-upon-Tyne. We now have pleasure in giving further particulars of this instrument, which will replace the old 15in. refracting telescope in the 38ft. dome at the Observatory. The old instrument was made by Sir Howard Grubb in 1872 for the Dunecht Observatory of the late Lord Crawford, and it was presented to the Edinburgh Observatory in 1892. It is now being reconditioned by Sir Howard Grubb, Parsons and Co. at their optical works at Walkergate, Newcastle-on-Tyne. The new instrument to be described, which is the largest reflecting telescope in Great Britain, has been designed and constructed by the same makers in collaberation with Professor Sampson, F.R.S., the Director of the Observatory. In Figs. 1 and 2 on the opposite page we reproduce two views of the instrument erected in the maker's works, and in Fig. 7 a sectional drawing of the telescope is given.

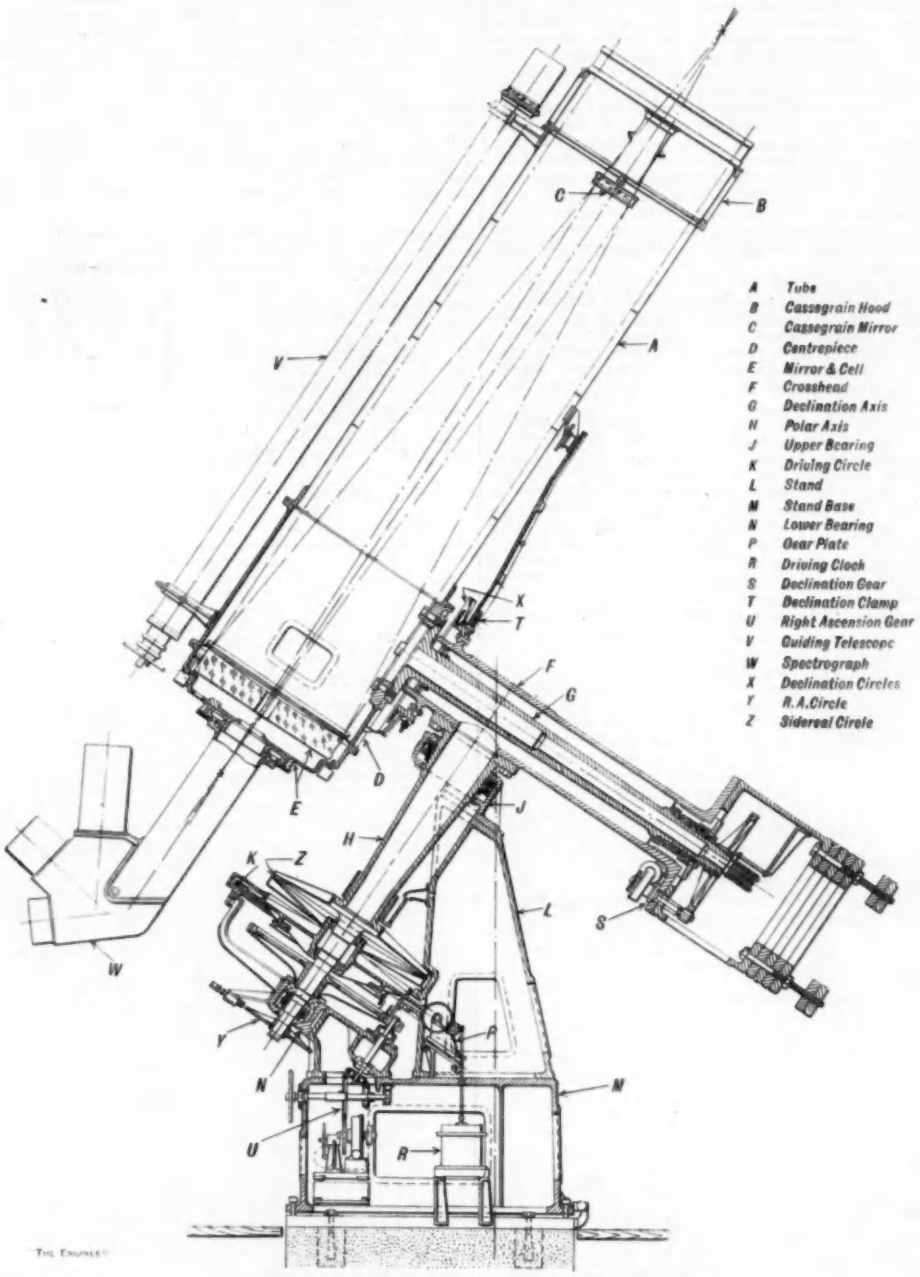


FIG. 7—VERTICAL SECTION THROUGH TELESCOPE

It is of the Cassegrain form, and will be used chiefly for spectrograph observations, in conjunction with a spectrograph made by Adam Hilger, Ltd., of London, but it will also be adaptable to other purposes.

The optical system consists of two essential parts—the great, or parabolic, mirror, which is 37in. diameter and 6in. in thickness, with a central hole, 3¼in. diameter and a focal length of 15ft. (F/5). The secondary, or Cassegrain mirror, is of hyperbolic section, and is 10in. in diameter. It is used in conjunction with the main mirror, and is designed to give an equivalent focal length of 54ft. (F/18), the rays passing through the aperture in the great mirror and being brought to focus at a point about 22in. behind its front surface.

General Arrangement of Telescope Mounting.—As will be seen from the drawing—Fig. 7—the equatorial mounting is of the usual crosshead type, in which the declination axis is placed above the upper bearing of the polar axis. The main stand is built up of three iron castings, the lower part forming the base, which is about 4ft. 9in. long by 3ft. wide, with a height of 2ft. 6in. This stand carries the upper and lower bearings for the polar axis. The gear plate and the controls are mounted in the upper part of the stand, while the driving clock and the right ascension quick motion gear are fixed in the lower part. When in service the apertures in the stand are closed by removable plate glass windows mounted in teak frames.

The polar axis is made in two parts, the upper portion consisting of a tapered iron casting, the lower part being a steel forging rigidly attached to the upper part. It is inclined at an angle of 57 deg. to the horizontal to suit the latitude of Edinburgh, and is mounted in self-aligning ball bearings, with a ball thrust bearing at the lower end. During the process of manufacture the whole axis was very carefully turned, and the final trueing up of the upper and lower pivots, and the fitting for the driving circle was done in a vertical lathe on a dead centre at the bottom and a steady bearing at the top of the axis. The driving wheel—see Fig. 4—is of cast iron, and is mounted on ball bearings on the polar axis, so that it can turn freely upon it. The rim on which the teeth are cut is of bronze, there being 1080 teeth, with a pitch diameter of 54·137in. The teeth were set off from a very accurate master circle graduated on silver, mounted concentrically upon it, each line on the master circle being brought into coincidence with the graticule in a reading microscope for cutting each tooth. A second microscope, on the opposite side of the master circle, was used as a check.

An interesting piece of mechanism is the right ascension clamping gear. When the telescope is required to follow a star, the driving circle must be clamped to the polar axis. The method of doing this is quite novel. On the quick motion gear, which is keyed to the axis, there are mounted three small hydraulic cylinders, the pistons of which act on three levers fitted with wedge-shaped shoes. A small hydraulic accumulator—illustrated in Fig. 8—is kept automatically charged by a ⅓ H.P. motor-driven pump, which supplies liquid under pressure. The accumulator can be placed in any convenient position in the observatory, a pipe from it being led into a rotatable joint fitted to the lower end of the polar axis of the telescope, and from thence by branch tubes to the hydraulic cylinders. When the liquid, which is a mixture of glycerine and water under a pressure of 100 lb. per square inch, is allowed to enter the cylinders, the wedge-shaped shoes are forced into a "V" ring mounted on the driving circle. This action clamps the circle rigidly, and without any side strain, to the axis. The valve controlling the liquid is actuated by means of solenoids.

The crosshead, which is made of cast iron, is rigidly bolted at right angles to the flange formed on the upper end of the polar axis, and the declination axis, which is of forged steel, is mounted in the crosshead in two radial ball bearings and a double thrust bearing. The inner end of the axis is formed into a flange 23in. diameter, to which the centre piece of the tube is bolted.

The tube consists of three parts, namely, the centre cast iron casting, which is bolted to the end of the upper steel part, with its lattice extension at the top to carry the Cassegrain mirror mounting, and the main mirror cell bolted to the lower flange of the centre iron casting. The main mirror, it may be remarked, rests on nine circular pads, each 4in. diameter, which are mounted on three triangular supports, and are so disposed as to give an equal pressure on nine portions of equal area of the back of the

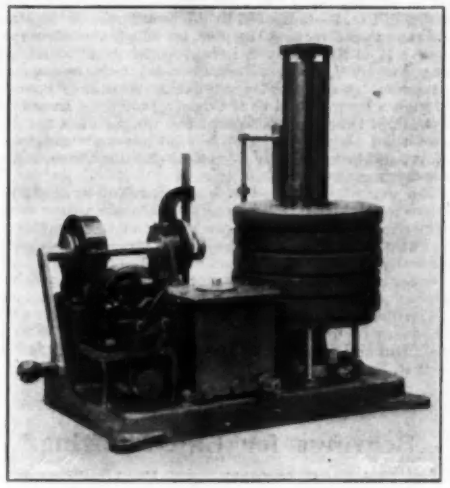


FIG. 8—HYDRAULIC ACCUMULATOR

mirror. Nine weighted levers are disposed around the cell, and these are mounted on universal joints and engage with eyes which are mounted on a flexible band which is clamped round the periphery of the mirror. The object of these levers is to take the weight of the mirror gradually as the tube is inclined towards a horizontal position. A roller blind is fitted in front of the mirror to protect it when not in use.

Telescope Setting Arrangements.—At the outer end of the crosshead there is mounted the motor-driven quick-motion gear for the rough setting of the telescope in declination. The right ascension quick-motion gear—see Fig. 5—is similar to the declination quick-motion gear, and is mounted on the lower part of the stand and operated by a ½ H.P. reversible motor. Both this gear and the declination gear are furnished with friction governors, which limit the speed of rotation of the axis to four revolutions per minute. A view of the breech end of the telescope showing the declination slow-motion gear is given in Fig. 3. The motors are automatically disconnected from the gears when not in use. A right ascension circle, 18in. diameter, graduated on silver and read by a micrometer microscope,

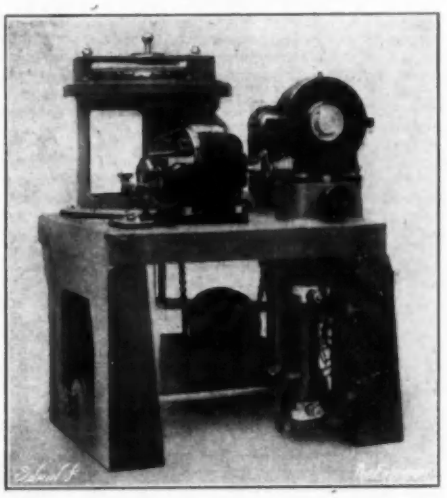


FIG. 9—DRIVING CLOCK

is mounted on the toe of the polar axis. It will be seen to the left of Fig. 4. The siderial circle is 42in. diameter, and is roughly graduated and figured. It is mounted on a boss formed on the driving circle and can be set by hand to siderial time. The declination circles are mounted on the inner end of the crosshead. The fine circle, which is 30in. diameter, and is graduated on silver, is read by means of two micrometer readers attached to the tube, while the rough circle, which is 36in. diameter, is graduated to single degrees.

The declination clamp and slow motion is fitted on to a "V" ring attached to the inner end of the crosshead, and the clamping is effected by means of either of two hand wheels fixed at opposite sides of the lower end of the tube. The outer end of the clamp arm carries a nut engaging with a fine thread screw mounted in a bracket attached to the side of the tube, and this screw carries a worm wheel engaging with a worm, which is in turn connected

to the motor-driven slow-motion gear. Two speeds are provided, one for guiding, which gives a movement of the tube of 15 seconds of arc in one minute of time—or one complete revolution of the axis in sixty days; and the other speed, for setting, is about thirty times faster.

The Guiding Telescope and Finders.—A guiding telescope of 7in. aperture, fitted with a two-lens apochromatic objective of 12ft. 7in. focus, is fixed alongside the main tube. The eye piece is mounted on cross slides with quick and slow motions, allow 3in. travel in the two directions, the position scales being electrically illuminated. The spider lines in the eye piece can be viewed either bright against a dark field, or dark against a bright field, as desired, and there are three eye pieces provided, giving magnifications of 200, 400 and 600 diameters.

Two finders are provided, first, a telescope of 3in. aperture by about 3ft. focal length, with a magnification of 18 diameters; and, secondly, a prism monocular, magnifying nine times, with an objective of 35 mm. diameter.

The Driving Clock and Gear Plate.—The driving clock—shown in Fig. 9—is housed in the lower part of the stand, and mounted direct on the pier, on which the telescope is fixed. It is driven by a weight which is automatically wound up by $^1/_{20}$ H.P. motor, the speed of the motor being controlled by means of a regulating resistance operated through a lever linked to the driving weight. In practice it is found that the position of the weight does not vary more than about $\frac{1}{4}$in. The friction governor makes 120 r.p.m., and is coupled by a vertical shaft to the gear plate and driving screw.

The gear plate is fitted with a controlling mechanism—shown in Fig. 6—which receives an impulse every second from one of the standard clocks in the Observatory, so that any errors in the speed of the driving shaft are automatically corrected by means of differential gears.

Quick-slow and slow-slow motions, actuated by a hand commutator for setting and guiding, are also provided.

The instrument which we have briefly described is a very fine piece of workmanship, and is a great credit to the engineers and physicists who together have designed and built it.

Bearings for Line-Shafting.*

By Professor G. F. CHARNOCK, Member of Council.†

IT may be said that the shaft is the essential element concerned in power transmission, and even with the widespread adoption of electric driving, it must continue to be employed on a very extensive scale. In many large establishments with mechanical transmission, or in those electrically driven throughout on the group system, the shafting in use, varying from 2in. to 4in. in diameter, may have a total length of several miles. In such a case, thousands of bearings are required, and it is therefore important that the loss of power due to friction should be reduced to a minimum. In modern practice this is accomplished either by means of "plain" bearings in which special attention is devoted to proper methods of lubrication, or by the use of ball or roller bearings, in which rolling is substituted for sliding friction. It is proposed to discuss the merits and limitations of each of these two main types of bearings for power shafting.

[After summarising the theory of film lubrication, the author proceeded as follows:—]

According to the hydro-dynamical theory of lubrication, it follows that if the journal and its bearing are completely separated by an oil film, the action of the lubricant is due entirely to its viscosity, and the only force opposing rotation is that necessary to overcome viscosity or to shear the lubricant. As the rubbing surfaces do not come into metallic contact when running, there can be no wear of the moving parts, and the power absorbed in friction should be reduced to a very small amount indeed. It also follows that the materials of which journal and bearings are composed can have no influence on the coefficient of friction. Further, the use of oil grooves, which may tend to sever the film, ought only to be adopted in full knowledge of the consequences.

So far as the viscosity of the lubricant is concerned, it is often submitted as common experience that, except at very high temperatures, oils of animal and vegetable origin are better lubricants than mineral oils of the same viscosity, and we are reminded that a good lubricant possesses some property described as "oiliness," to which its value in reducing friction may be largely attributed. It should not be overlooked that these results refer to semi-fluid friction, where the parts are more or less in actual contact, and do not apply to film lubrication as prescribed by theory.

It is well known that wear does take place to some extent even under the most favourable conditions, despite the fact that the greatest care has been taken in the selection of the most suitable lubricant, and in keeping down the bearing pressure within safe limits to prevent squeezing out the film. But the result is no doubt due, as already explained, to the rupture of the film which occurs at starting and stopping, leading to temporary running under conditions of semi-fluid friction with the parts actually in contact. Under such conditions, a certain amount of wear or abrasion must necessarily take place until the film has formed, and the minute particles of metal produced by this abrasive action are held in suspension in the lubricant, in which they circulate continuously through the bearing. As such particles increase and accumulate, they are not only the cause of additional wear, but may ultimately tend to destroy the continuity of the film, and possibly the actual working conditions may degenerate into a combination of film and greasy lubrication. A similar action may also be caused to some extent by the presence of gritty particles in the lubricant, and in this respect the practice of filtering the oil before use has much to recommend it.

It must be admitted that in practice the materials of which the rubbing surfaces are composed do exercise considerable influence on friction and wear. But in all probability this applies only when the oil film is ruptured and metallic contact with greasy lubrication results. The nature of the bearing materials is not of so much importance when conditions of film lubrication have been restored.

Lastly, it is known that oil grooves may be used in some types of bearing with decided success. There are certain instances, usually at low speeds and with high pressures, in which the conditions necessary for fluid friction cannot be fulfilled, and here the use of oil grooves is, to say the least of it, desirable if not absolutely necessary. Sir Thomas Stanton has shown‡ that with "boundary" lubrication, grooving, if properly located, may be applied with advantage to give the oil access to the whole of the bearing surface. The fact, however, remains that with oil grooving, film lubrication is out of the question. In an ordinary line shaft bearing, therefore, if it is sought to realise the conditions of film lubrication, grooving should not be resorted to.

It has often been felt that the points enumerated should be subjected to actual test and experiment, and the author therefore carried out in the engineering laboratory of the Bradford Technical College a large number of tests for Mr. F. Wigglesworth, of Shipley, to ascertain the efficiency of various types of line shaft bearings, under varying loads and at different speeds. The results were sufficiently encouraging to lead to the design and construction of the special bearing testing machine shown in Fig. 1. The test shaft A is a short, stiff shaft, 3in. in diameter, supported in ball bearings B, C, and D, which are attached to a strong cast iron base plate E. The test shaft is driven by means of fast and loose pulleys F G from an electric motor, a variable-speed gear being interposed to permit any desired speed to be obtained. The bearing H under test is applied to the shaft A in the usual upright position midway between the bearings B and C, and is mounted on a frame I suspended by two links J K from the beam L, which, by means of a third link M, hangs from the end N of the short arm of the main lever N O P. The fulcrum O of the main lever, and the ends of the links J K M are provided with knife edges to reduce friction. A double-side jockey weight Q may be moved along the main lever to enable the total load on the bearing to be adjusted to any desired amount within the limits of 1100 lb. and 6000 lb. With the jockey weight shown, the machine is therefore capable of applying a pressure of from 60 lb. to 350 lb. per square inch of projected area on a 3in. bearing two diameters long, while for lighter loads a smaller jockey weight may be substituted. The friction moment is measured by means of the graduated steelyard R, and is counterbalanced by moving the small poise weight S until the lever is brought to its zero position, as indicated by the spirit level T. In making a test, the shaft is run alternately in a clockwise and a counter-clockwise direction, and the mean of the two friction readings is taken. As the lever R is graduated on both sides of the centre line, it is only necessary to move the weight S to right or left, as the case may be, to obtain the torque readings. The method of loading the bearing, and of measuring the friction torque is shown diagrammatically in Fig. 2. With this machine Mr. Wigglesworth has made hundreds of tests on actual bearings under conditions approaching as nearly as possible those which obtain in ordinary running, and much information of great value in every-day practice has been acquired regarding materials, workmanship, methods of lubrication, class of oil, &c. The results of a series of tests on a rigid ring-oiling plummer block, 3in. diameter, with gun-metal steps 2 diameters long—Fig. 3—to ascertain the value of the coefficient of friction at varying speeds and pressures are shown in the diagram—Fig. 4. Before proceeding with the tests, the machine was run about sixteen hours under moderate load until the bearing had "run itself in." The oil used was "Gargoyle Vaculine C," extensively employed for bearings of this character in ordinary mill practice. The reduction in the coefficient of friction with increase in pressure was most marked, falling from 0·0094 with 25 lb. per square inch to 0·0016 with 300 lb. per square inch. It was also noticed that beyond a speed of 250ft. per minute some falling off took place with increase in speed. The temperature of the bearing was therefore measured at frequent intervals during the test, and it was found that the diminution in viscosity caused by the rise in temperature was the cause of the reduction in the value of μ at the higher speeds. The viscosity of the oil was therefore measured by means of a Michell viscosimeter, which was found quite useful for this purpose. All the results have been plotted in Fig. 4, and in this way the maximum loads and speeds to which the various types and sizes of bearings may be subjected have been analysed and determined. The important conclusion has been arrived at that in many cases the bearing surfaces of plummer blocks, &c., used in mills and factories are too large and the load too light, not only for maximum efficiency, but even for economy and freedom from trouble in running. The practice of adopting large surfaces and long bearings with the supposed object of reducing friction and wear is not justified in many cases, and can only be regarded as mistaken economy in first cost and in running. It was also shown that bearings lubricated by oil bottle or syphon cups are very inefficient, the coefficient of friction being on the average four times as great as with ring oiling. Some interesting results were also obtained with grease lubrication—Fig. 5—and the machine has

FIG. 1.—*Bearing-Testing Machine.*

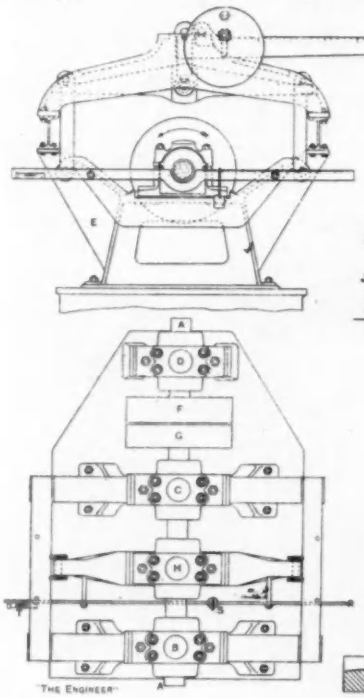


FIG. 2.

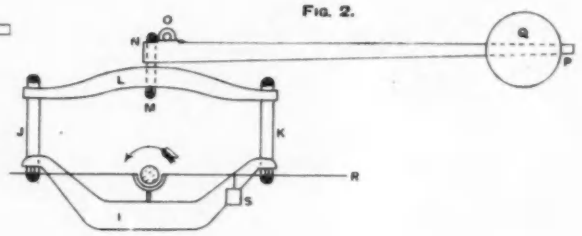


FIG. 3.—*Rigid Ring-Oiling Plummer Block.*

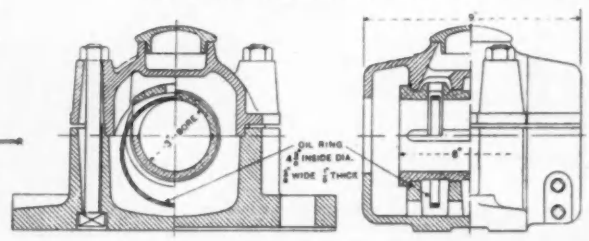


FIG. 4.—*Coefficient of Friction at various Rubbing Speeds and with varying Loads.*

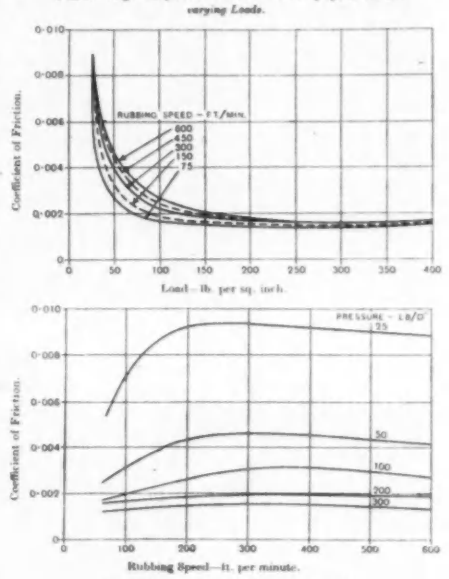
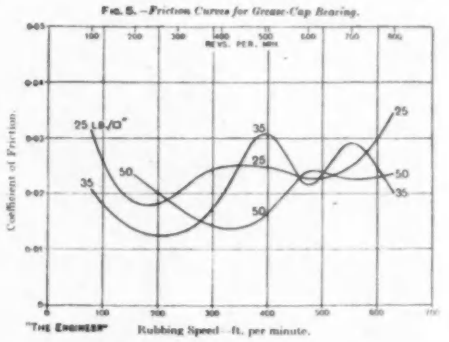


FIG. 5.—*Friction Curves for Grease-Cup Bearing.*



* The Institution of Mechanical Engineers. December 13th. Abstract.

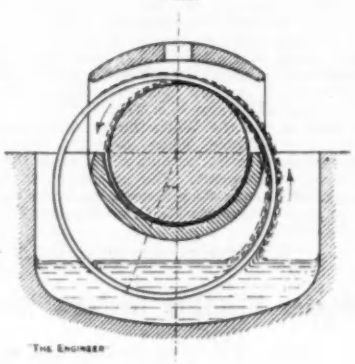
† Professor Charnock died on November 7th, 1929.

‡ THE ENGINEER, 1923, Vol. 135, page 678.

enabled useful comparisons to be made between self-oiling, ball and roller bearings.

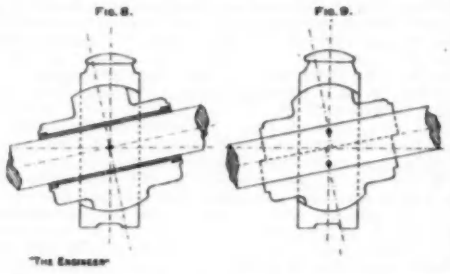
The results of these tests have shown unmistakably that as regards its suitability for line shafting, the ring oiling type of bearing stands out prominently, and may be accepted as the safest and most efficient type under ordinary conditions of service. In the ring oiler—Fig. 3—which may be regarded as an adaptation of the bath method of lubrication, the feed operates only when required, *i.e.*, when the shaft is in motion. The lower part of the ring dips into an oil reservoir formed in the bottom

FIG. 6.



half of the body of the bearing, and the action of the ring in lifting the oil is illustrated in Fig. 6. The ring revolves at a slower speed than the shaft because of the friction of the ring in the oil, and the velocity of the ring is controlled by the relation between the friction of the ring on the shaft, and of the ring in the oil. The greater the friction between the ring and the shaft, and the less that of the ring in the oil, the greater the speed of the ring. The weight of the ring itself is important, and the relative sizes of shaft and ring also exert some influence. The ascending side of the ring always carries more oil than the descending side. As a result there is always some displacement of the ring

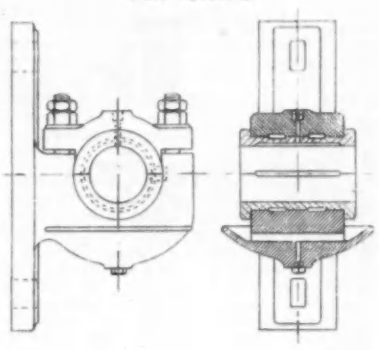
FIG. 8. FIG. 9.



from the perpendicular, which must be allowed for in the design of the bearing, or the oil may be scraped off the ring by the edge of the slot in the bearing to such an extent as to render lubrication almost inoperative. The ring must not be allowed to come in contact with the interior of the casing, or rotation may be prevented. The oil is delivered to the bearing along groove running to within $\frac{3}{4}$in. of each end, and after passing over the surface of the journal, is returned to the reservoir for further use, thus ensuring a constant circulation. For this reason, the bearing must be made dustproof, the joint between cap and body being machined, and an oil-throwing device should be provided to prevent oil creeping along the shaft. As an additional safeguard, self-contained completely enclosed dishes are sometimes embodied in the casting, and felt washers or textile pads secured at each end of the bearing by brass plates held in position by countersunk screws, should be employed to close the space between the oil dish and the bearing. Too much importance cannot be attached to these apparent refinements.

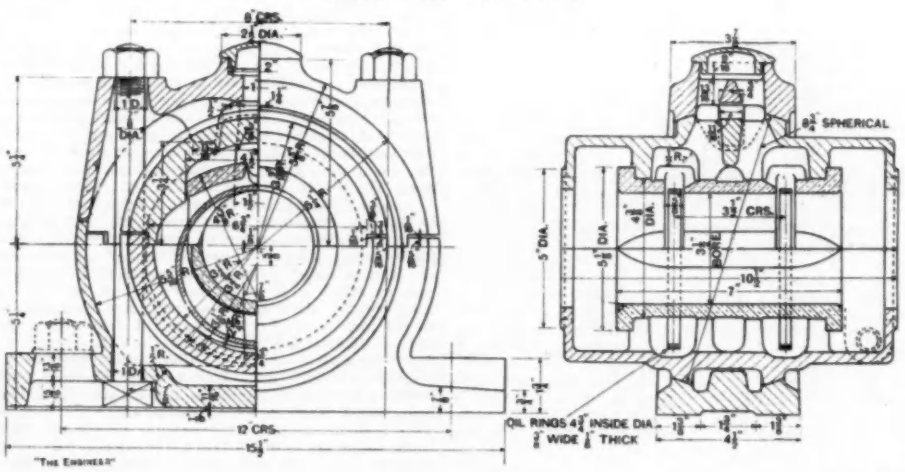
Bearings are classified as either rigid or swivelling, to each of which the same methods of lubrication and of adjustment for purposes of alignment and level, are equally applicable. An example of the old-fashioned rigid bearing, which is still in extensive use, is shown in Fig. 7, this particular type, known as a side plummer block, being intended for direct attachment to hanger, column, or stanchion. It will be seen that the bottom step may be removed without dismantling the shaft. The cap is drilled and tapped for lubricator, and self-contained oil dishes communicating with each other are provided, both of which may be cleaned out by removing the set screw underneath. With a rigid bearing it is essential to efficiency and durability that the shaft should bear over the full length of the bearing. This may be attained on erection, but due to subsidence of foundations, deflexion of columns,

FIG. 7.—*Rigid Bearing.*



walls, girders, &c., from which the shaft is supported, some displacement will almost inevitably occur after running some time under full load. Shafting in factories is frequently found to be very much out of line and level, and in consequence a considerable amount of power may be absorbed in the drive. The swivelling or self-aligning bearing was first introduced by Sellers about sixty years ago to overcome this defect. This bearing automatically adjusts itself to the shaft, and is independent of exact level or alignment of fixings on which it is supported, thereby ensuring that the shaft is in full contact throughout the whole length of the bearing. Diagrams are frequently exhibited showing in an exaggerated manner the difference between the rigid plummer blocks and the self-aligning bearing, not in line or level with the shaft. In the first case, the shaft bears "hard on" at each end of the bearing, causing excessive friction, heating, and wear. The swivelling or self-aligning bearing, on the other hand, automatically adjusts itself to any slight changes in the direction of the shaft. Its use also saves much time in erection, and in this respect overcomes in a very effective manner a serious disadvantage of the rigid plummer block. The swivelling bearing has turned spherical seatings which rest in spherical machined cavities in the body and cap of the pedestal respectively, thus permitting ball-and-socket action. It is necessary to call attention to a point which is often overlooked in the design of a bearing of this type. The radius of the spherical portion of both body and cap must be the same, and must be struck from the centre of the bearing at the intersection of the vertical centre line with the centre line of the shaft, as in Fig. 8. Very frequently, the spherical portions are made with different radii and the centres do not fall on the centre line of the shaft, as in Fig. 9. It will be seen that with the latter arrangement, sliding of the cap relative to the body must take place. Owing to the shape of the cap and body, the form of this bearing—shown in Fig. 10—has become known as the "girdle" type, and when fitted with bearing surfaces of either gun-metal or anti-friction metal, and provided with self-lubricating ring oiling, may be regarded as the most perfect type for line shafting. Such bearings are usually made from $1\frac{1}{2}$ to 2 diameters long.

FIG. 10.—*"Girdle" type Bearing.*



Self-adjusting bearings made in halves of close-grained cast iron carefully bored to a very smooth and true surface, have been used with considerable success. In the original form the bearing was made 4 diameters long, and lubrication was effected either by means of a syphon lubricator screwed into the centre of the cap or by two grease cups, near the ends of the upper half bearing, oil catchers at the ends being provided in either case. It has been found that this bearing should not be loaded to more than 50 lb. per square inch, or less than 35 lb. per square inch of projected area, and with modern ring-oiling methods of lubrication, the length of the bearing surface need only be 3 diameters. Even within these limits of pressure, the coefficient of friction is greater than with gun-metal-lined self-lubricating bearings.

In the grease cap bearing, which may be either of the rigid or swivelling type, as shown at (*a*) and (*b*) respectively in Fig. 11, a yarn setting saturated with grease is packed into a large cavity contained in the cap of the bearing. This has found much favour in some quarters, the advantages claimed being cleanliness and economy in the use of lubricant, simplicity of application, and automatic action, as well as the point—which appeals to many engineers—that very little supervision is required. For slow speeds and high bearing pressures, or where the temperature of the rubbing surfaces is high, a lubricant of high viscosity is, of course, required. But the frictional resistance due to viscosity, or, in other words, the fluid friction of the lubricant itself, is often overlooked. As this depends largely on speed, it follows that for slow-speed machinery running at 30 or 40 r.p.m., with heavy journal pressure, the use of solid grease represents correct practice. But the power absorbed by the internal friction of the grease itself increases as the square of the speed. If the speed be increased ten times, the power absorbed is nearly one hundred times as great as before, and as this is mainly converted into heat, it becomes difficult to maintain a cool bearing unless artificial cooling be resorted to.

Lubricating greases are of two kinds:—(1) A pure mineral product and (2) an emulsified mixture of mineral oil, tallow or other fat, and soap. Semi-solid lubricants are also produced by working up animal fats or vegetable butters with soap and water, or mineral oils of extreme viscosity may be thickened with soap. These substances cannot be described as remarkable for their lubricating properties. The soaps used are of the ordinary lime, soda, or lead types, which frequently contain caustic soda in excess. When in use this is converted into carbonate of soda, and trouble due to cut bearings may result. Greases are especially liable to contain free fatty acids, which speedily corrode the metal parts on which they are used. If the grease consists of thickened mineral oil, the oil content may be squeezed out, and the soap body left

FIG. 11.—*Grease-Cap Bearing.*

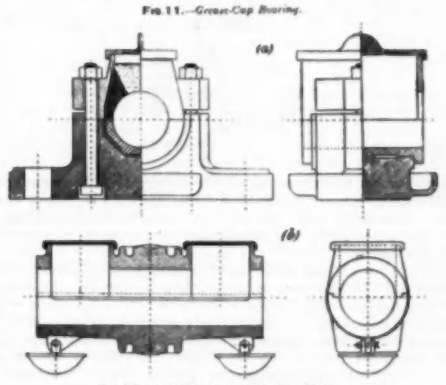
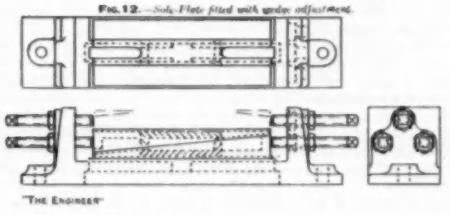


FIG. 12.—*Side Plate fitted with wedge adjustment.*



behind takes up dirt and abraded particles with which it forms a hard, gummy coating in the bearing. In this way friction is increased to an enormous extent, and cutting both of shaft and bearing is bound to ensue. In using a grease lubricant, care should be taken to obtain a really reliable variety. There is no doubt that pure high-grade solidified oils and greases may be successfully used for bearings which have to withstand heavy duty. It does not, however, follow that this is equally true for lighter work at moderate speeds. The use of grease as a lubricant for ordinary shafting is not to be recommended, as it certainly wastes power by resistance to motion due to its extreme viscosity. Tests with mill shafting have shown that the extra loss due to solid grease as compared with oil will reach $2\frac{1}{2}$ per cent. of the full load. It therefore remains to determine whether the user gets an equivalent in other directions, so that the additional expenditure of power as compared with oil lubrication may be regarded as fully offset by the advantages claimed for grease.

Fixings for Line Shaft Bearings.—Supports for shaft bearings are classified according to location, whether fixed to floor, wall, column, or overhead girder. Such fixings, as they are termed, comprise floor stands, wall boxes, wall brackets, column brackets, and hangers. The bearing proper is attached to the fixing in such a manner as to permit of a certain amount of adjustment, both vertically and horizontally. The present tendency is to provide a mechanical form of adjustment, which not only facilitates erection, but is a great convenience when any readjustment of the shafting has to be effected. An instance of this is shown in the sole plate—Fig. 12—fitted with wedge adjustment, which may also be applied to any other type of fixing. The upper surface of the fixing is planed, and the wedges are machined on both faces, which results in a very simple and accurate levelling device. The same principle is carried a step further in the modern design of fixing provided with four-way adjustment—Fig. 13—which is equally applicable to hanger, bracket, or stand. The bearing may be adjusted both vertically and laterally within the frame by means of screws, which constitute an inexpensive and reliable adjunct for facilitating erection, and for making any subsequent correction in alignment due to subsidence of the building or other cause. For all normal transmissions, it is safe to say that this is the cheapest and best form of shafting support extant. The bearing itself is of the swivelling type, giving ball-and-socket action and free alignment to the shaft. The bearing should be supported not on the points of ordinary set-

screws, as in some makes, but on machine-cut, square-threaded, mild-steel plungers of ample diameter, the ends of which are machined to form a proper seat for the spherically machined faces on the top and bottom of the bearing. This is raised or lowered by the adjusting plungers until it is brought to its correct vertical position. It is then free to be moved laterally by adjusting side screws which pass through elongated slots in the sides of the frame to permit them to follow the vertical movement of the bearing, and at the same time to bear always at the level of the shaft centre. After the shaft has been levelled and lined, the adjusting screws may be locked in position by means of the lock nuts with which they are provided. The frame may with advantage be constructed with a parting yoke for either side or bottom opening, as most convenient, to permit easy erection or dismantling of the shaft.

FIG. 13.—*Four-way adjustment Bearing.*

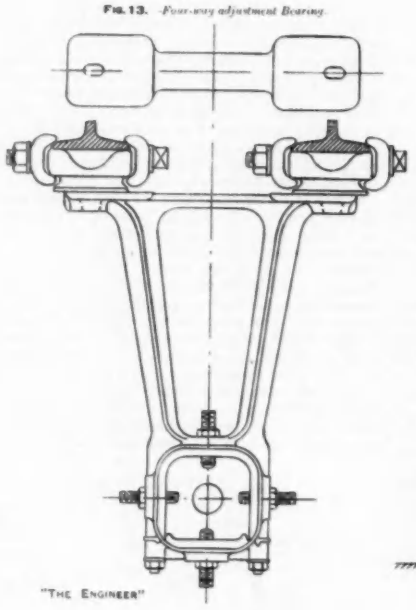
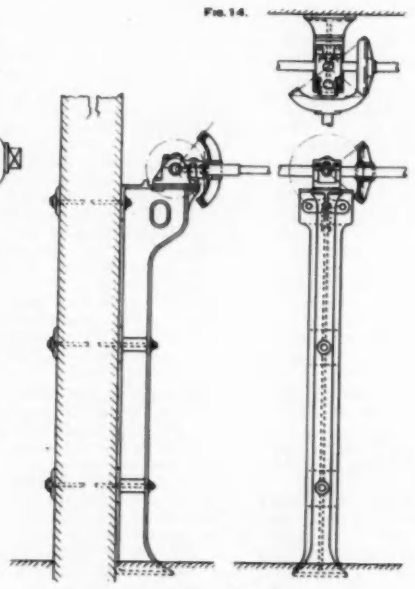


FIG. 14.



If the wall is not sufficiently reliable to support the drive, especially in the case of heavy bevel gearing, pilasters or wall columns—Fig. 14—may be used with advantage. The methods of attaching brackets to columns or of hangers to joists should be arranged in such a way as to enable fixings of standard pattern to be employed without alteration. By using column clamps and girder clips, as illustrated in Fig. 14, this may be accomplished in a very neat and effective manner.

Erection and Alignment of Shafting.—Many tests have been made both by mechanical and electrical means which show that from one-third to two-thirds of the power applied is required to overcome the friction of the shafting. It may be taken that in the manufacturing districts of Lancashire and Yorkshire the loss of power due to friction amounts on an average to 35 per cent., reaching in some extreme cases as much as 50 per cent. It is generally assumed that this loss is primarily due to weight of shafting and pull of belts, but there is no doubt that inaccurate methods of supporting and aligning shafting preclude the possibility of anything approaching an economical drive. The subsidence of foundations, bulging of walls, and deflexion of columns and girders, take place to a greater or less extent after the mill is set to work, and necessitate frequent examination and testing of the whole installation.

It is impossible when levelling shafting to obtain correct results by the ordinary method of using a spirit level not more than, say, 9in. long, placed on the shaft at various points between the two bearings. A straight-edge at least 6ft. long—and longer if convenient—should be used for testing discrepancies in level. A better plan is to hang the straight edge on hooks suspended from the shaft, and place the spirit level on the straight edge, but it is scarcely possible to adjust a line over 50ft. long in this way. Where possible, an engineer's dumpy level should be used in place of the spirit level. All shafting should be inspected at least once a year in this way.

(To be continued.)

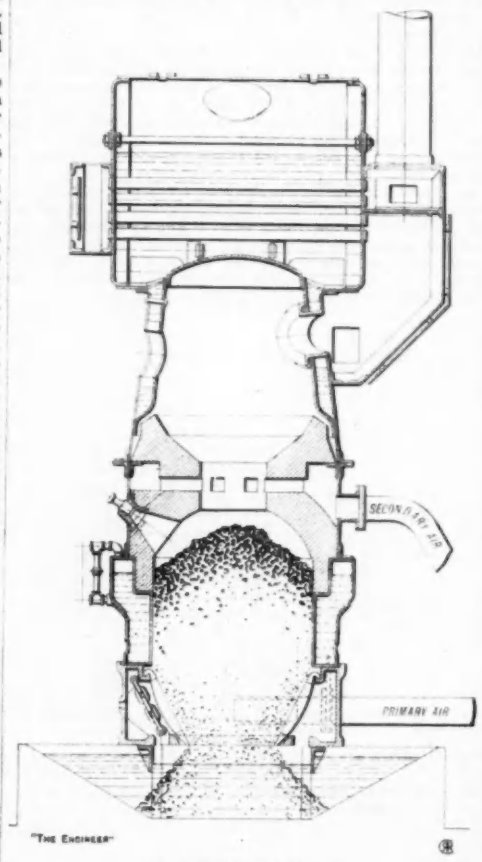
Wignall-Wollaston Producer Boiler.

AT a recent exhibition of smoke abatement appliances held in Manchester, the steam for some of the exhibits was supplied by a Wignall boiler fitted with a Wollaston gas producer furnace, made by Hartley and Sugden, Ltd., of Halifax. From a sectional view of the boiler, which is given herewith, it will be seen that it is a combination of the vertical and horizontal types. The lower portion is similar to that of most vertical boilers, but the upper part consists of a horizontal steam and water drum fitted with smoke tubes, the two portions of the boiler being connected by means of an insulated smoke casing. The products of combustion on leaving the fire-box are led by means of this smoke casing to the lower bank of tubes, through which they pass to the front of the boiler, then back through the upper bank of tubes to the flue.

The arrangement combines the spacious fire-box of the vertical boiler with the long flue travel of the horizontal boiler, which, it is claimed, enables the maximum of heat to be abstracted from the products of combustion. The smoke tubes are entirely submerged and there are no tube ends in the fire-box. The upper drum gives a larger steam space than is found in most vertical boilers and, incidentally, a larger surface area of water, while the head-room required is less. Accessibility for cleaning is obtained by manholes, mudholes and tube doors, by means of which tube renewals can be effected easily.

The height of the boiler is 7ft. 3in. overall, and the horizontal drum is 4ft. 9in. long by 4ft. diameter, the heating surface 135 square feet and the grate area 7 square feet. The working pressure is 100 lb. per square inch, and the maximum rating 925 lb. per hour from, and at, 212 deg. Fah.

The furnace portion of the plant is a water-luted gas producer, the refractory crown of which is virtually a Bunsen burner. It is fan blown, the air discharge from the fan being divided into two streams, primary and secondary, which, by means of simple valves, can be regulated as required. The primary air, saturated to a degree corresponding with an average temperature of 58 deg. Cent., is regulated to make a high quality of producer gas in the upper part of the producer, while the secondary air, passing round the annulus in the hot refractory crown, is pre-heated prior to joining the gas at the Bunsen throat, where ignition takes place and a clear hot flame is produced.



PRODUCER BOILER

The low-pressure steam for the saturation of the blast is obtained from the water jacket round the producer, and the makers claim that the jacket is so proportioned that, at all loads, it provides the correct amount of steam necessary for saturation purposes. This jacket also acts as a water-cooled metallic wall which prevents the formation of clinker when using fuels containing fusible ash, or if any clinker does form, it is prevented from adhering to the walls. It further usefully employs the radiant heat of the oxidation zone of the producer. This water jacket is fed by gravity through a Royle water level regulator and is provided with a safety valve which blows off at 5 lb. per square inch.

The grate is a recently patented modification of the Mond grate, and the bars, instead of lying against a rigid base, rest upon a steel ring suspended by chains at three points. By the insertion of a poker, this ring can be swung very slightly, thus imparting a motion to the bars which is sufficient to bring the ash down uniformly. The ash zone is maintained up to a level at, or nearly corresponding with, the top of the bars, so that the losses of heat in combustible and sensible temperature in ash are very small.

At the Manchester Smoke Abatement Exhibition, the fuel used was cinders separated from the Manchester town's refuse, and it contained quantities of broken glass, broken brick, and other foreign materials. One analysis showed :—Moisture, 5·18 per cent.; ash, 27·43 per cent.; sulphur, 1·56 per cent.; combustible, 65·83 per cent., and the calorific value was 9185 B.Th.U.'s per lb. For this class of fuel the Wollaston producer appears to be particularly suitable, since its large capacity enables larger volumes to be fed at a time, while the removal of ash is very infrequent. The efficiency of this boiler is claimed to be over 80 per cent., and the percentage of CO_2 in the chimney gas 17½ when burning the fuel mentioned above.

Water Finding in New Zealand.

IT is worth while to be trained as an engineer even if you have to take to farming for a living. The passages printed below are taken from two letters written by Mr. Donald H. Lea to his brother, Fred, of Henry Lea and Son, Birmingham. They will be read with interest :

OCTOBER 9TH, 1929.

". . . The water question became urgent, and as well-digging in this spewing sand below me is only possible in March, the dryest time of the year, I thought I would see what happened if one drove a pipe into the ground. I got the local blacksmith to make me a steel shoe, and I put it on a 1¼in. G.I. pipe, and then drilled ¼in. holes (14) for 2ft. up from the bottom of the pipe, put up a rickety staging that let me get 16ft. up in the air, and started to belt an 18ft. pipe with a 20 lb. mawl. It took twenty blows to drive an inch, but I got it down and found I was still in spewing sand. So I put on another 12ft. length and belted 8ft. of that in, and then I nearly wept, for the pipe broke at the socket in the ground, and I couldn't dig down to it because the surface water was within 3ft. of the surface. The water had risen in my pipe to within 2ft. 6in. of the surface, and I could not even try to clear the pipe. There was nothing for it but to start all over again with another pipe close to the original one. This time I started with a 2in. pipe and a 20ft. length, and put up shear-legs 26ft. high with a rope and pulley to take a monkey that weighed 105 lb. and which had a ¾in. pipe 5ft. long in the 2in. pipe to guide it. That was hard work, but I got the 2in. pipe down 19ft. and couldn't clear it (still sand), so put on a 12ft. length again and borrowed a monkey weighing 160 lb. and got a neighbour to come and help me to pull the thing up 3ft., or 4ft., and then let it drop. Well, we got down 29ft. and the going was very hard—a blow meant about ⅛in. into the ground—and I said 'Come on, I'm nearly dead and so are you, but let's put her down the last foot before it's time to go and milk.' We began. There was a smash and a clatter, and the pipe guiding the monkey broke in the monkey and went straight down to the bottom of my 2in. pipe! I nearly tore my hair. I had to fish for the —— thing in a 2in. pipe 24ft. down. However, I hunted amongst my files and found a square file with a nice point and taper on it, put a thread on the tang and screwed it into a ¾in. socket, and so on to ¼in. piping. You'll hardly believe it, but the very first time I lowered 27ft. of ¼in. piping down the 2in. pipe, the file went straight into the broken pipe! I said to old Dent, the man who was helping me, 'I've got it!' He said 'I don't believe you.' I said 'Yes, I have. Give me a hammer and stand by to grab the broken pipe when the end shows.' So I tapped the file into the broken pipe and began to lift. I knew by the weight that I had it on, and I got it up about 15ft., and plunk—down it went to the bottom again. Now here's something more to try your belief. I swore, and lowered the gear again, and went straight into the ¾in. pipe again. This time I remembered that files are cut on an angle, and I screwed the file in instead of tapping, and got the dam' thing out. The whole business took about half-an-hour, and I thought,' Well, I shall be lucky if I get it out in a week.' It had to come out, because the only way I found to clear all the sand and muck out of the well-pipe is to force water down a ¼in. pipe and bring it up to the surface so. You can't get it through a pump. So I made a sledge and mounted a 40-gallon barrel on it, and get water from my well near the house, and have to sledge it over to the new well with the horse. I have just begun to try and clear a hole in the ground at the bottom of this 2in. pipe 30ft. down, and I don't know whether I shall manage it or not yet. It is a most laborious business. I have, after endless trouble, fixed up a No. 4 Douglas hand pump fitted to a C.I. trap to catch the bulk of the dirt that comes up. That means, with a fine strainer, I can keep the hand pump going and pump about 10 gallons. By that time, the 2in. pipe has about 12ft. of muck in the bottom of it, and I have to change over to the ¼in. pipe and the force pump, and clear that out. Then it all begins over again. And all the water for the force pump has to be sledged a quarter of a mile. It has to be clear water, because I'm using a semi-rotary force pump, and sand or grit would ruin it in a day. However, if I get a good water supply, it will be worth all the trouble and work, and, my Lord, it has meant some work, but it has been an interesting job."

OCTOBER 10TH, 1929.

"Great excitement. By mid-day to-day I had got out two or three barrow loads of sand out of the 30ft., 2in. pipe, and was hand-pumping water clear of sand at 500 to 600 gallons an hour. Have just sent out a

batch of letters of enquiry for pumps and small engines, first and second-hand. Gosh, you don't know what this means to me. Incidentally, no one has ever succeeded in getting water in this locality in this way before, tho' it's a common enough method in gravel or shingle. I'll give you details some day of the sand trap I made, so as to avoid passing the sand through the pump. It worked like a dream and without it I could never have cleared the pipe. So ends the hoeing of another hard and long row. It's taken about all my spare time for two months."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

THE basic trades of the Midlands and Staffordshire show little change. A fair amount of work is in hand at the iron and steel and engineering works, but the Christmas holidays are upon us, and there is little inclination on the part of either buyer or seller to enter into fresh commitments. The business put through this week related to material urgently needed. A good run of trade in the New Year is, however, looked for, and manufacturers are in many cases clearing their works ready for a fresh start in 1930.

Finished Iron.

In the Staffordshire finished iron trade the general tendency is towards improvement. Order books have recently been strengthened with requisitions from the railways and rolling stock builders and projected development schemes promise further calls upon the resources of the industry. Staffordshire marked bars continue to sell at £12 10s. per ton and Crown bars at from £10 to £10 7s. 6d. Demand for Crown iron is small and irregular, and the trade could much do with a stimulus. Makers outside this area continue to take a large share of the available business. Their prices are well below those acceptable to Staffordshire makers. Nut and bolt and fencing bars sell only in small lots. Local makers ask £9 upwards for supplies. Belgian competitors take most of the business despite the inferiority of the material. Wrought iron strip still commands £11 2s. 6d., but there has been some slight falling off in demand. The Black Country tube works are not as actively engaged as they were a month or so ago. Ironmasters on 'Change in Birmingham to-day—Thursday—were generally bright and optimistic.

Pig Iron.

A good output of pig iron is maintained by Midland furnaces and some Derbyshire smelters report they have been unable to keep pace with specifications. Considerable arrears are said to have accumulated, with the result that output over the Christmas holidays is already ear-marked. Very few new orders are being received just now, but brisk business is anticipated in January, when a large number of contracts come due for renewal. The strong position which blast-furnacemen in this district have held for so long shows no sign of weakening, and the outlook for the industry is bright. Prices are firm, but have not advanced on the Association minimum basis. Derbyshire No. 3 foundry is £3 18s. 6d.; Northamptonshire foundry, £3 15s.; and North Staffordshire, £3 19s. 6d. Forge material is 4s. per ton less in each case. There are plentiful supplies of this grade of iron in stock. Demand in this department has been, and still is, poor. It is noted here that production of pig iron in November amounted to 631,400 tons, compared with 688,700 tons in October and 544,400 tons in November, 1928. During the month three furnaces ceased to operate, bringing the total number of active furnaces to 163. This perhaps, in some measure, accounted for the lower output. Of the production, 126,100 tons were foundry iron, 23,800 tons forge, 179,100 tons hematite, and 279,900 tons basic.

Furnace Coke.

There is no appreciable relaxation in the coke stringency in this area. Smelters and users of pig iron are very worried as to the future, realising that prices will depend to a great extent upon the happenings in the coal trade in the coming months. Present indications, it is considered, are against any improvement in the volume of supplies and any lowering of selling prices. Many blast-furnacemen in January will have to negotiate fresh contracts, and they are, at date, approaching their regular trading connections regarding renewals at the rates they are now paying. Many of them, it is thought, will have to concede an advance on present payments.

Steel.

Business in finished steel has been rather more active during the past week in view of the possibility of an increase in prices as a result of this week's meeting of the Steel Association. It is well known that some steel-masters consider an increase justified. Others, however, are more anxious to see trade develop than selling prices advance. Trade continues patchy. While some sections are fairly well employed, others are not at all well off. Competition in the structural engineering trade is very keen and Midland yards are not so well placed as those in the North. Up to the time of writing there had been no change in steel values, either finished or semi-finished. Continental steel bars, which are sold in large quantities to this district, are this week quoted £6 7s. 6d. delivered. Billets are cheaper than they have been during the past few weeks. Whereas the minimum for native billets is £6 2s. 6d., continental billets are to be had at £5 9s. Sheet bars from the Continent sell at £5 10s. against the Welsh price of £6. Very little business is being done, however, the galvanised sheet industry being in poor condition. The November output of steel ingots and castings amounted to 815,000 tons, compared with 889,800 tons in October and 762,500 tons in November, 1928.

Galvanised Sheets.

The galvanised sheet trade has made no recovery and few, if any, bulk orders are now expected until the New Year. Corrugated sheets of 24 gauge are freely offered at £12 10s., and quick delivery is promised. Consumptive demand alike at home and abroad, is very poor, and many mills in this area have considerable difficulty in carrying on. Values of lighter gauge sheets are unaltered, and while demand is not bright, it is a little better than in the case of 24 gauge. Black sheets are in regular call at recent rates.

Scrap.

The scrap market shows no change on the week. Demand is dull and values are unstable. Consuming works in South Wales are only slowly reducing their stocks, and few of them will need to replenish before the Christmas holidays.

Electricity in Shropshire.

A scheme, estimated to cost £300,000, for the distribution of electricity in the north-eastern sector of Shropshire has been approved by the West Midlands Joint Electricity Authority, and is to be submitted to the Electricity Commissioners for their approval. The Authority some time ago secured approval to a system of extra high-tension mains to form the foundation of a supply to the whole of the undeveloped area, representing about 600 square miles of the 1000 square miles controlled. The scheme now put forward is to give effect to this decision in the first portion of the area selected, the industrial portion of Salop. The area embraces about 109 square miles. It includes Wellington, Newport, Oakengates, and Dawley urban districts, parts of the borough of Wenlock, with Madeley, Coalbrookdale, and Ironbridge, and parts of the rural districts of Wellington, Newport, Shifnal, and Atcham. The proposed works include 33,000-volt transmission lines.

Town-planning Scheme.

Important new proposals for the setting up of statutory joint committees for the preparation of a comprehensive town-planning scheme for the areas of over thirty local authorities in South Staffordshire and the neighbouring districts have recently been considered by the Midland Joint Advisory Town Planning Council. The schemes of the various committees have been approved, and steps taken to ensure as far as possible uniformity of procedure. A model form of agreement for the use of those authorities who are being asked to take the initiative is to be drawn up.

Edge Tools.

The heavy edge tool trade in the Midlands, which has been quiet for some months past, now shows signs of improvement. A few good orders have been received from overseas, and there is the promise of more to come in the near future. Considerable augmentation of the present volume of business will be necessary before a normal level of trade in this industry is again reached.

Unemployment.

The latest unemployment returns for the Midlands area show a decrease of 775, the number having fallen from 159,961 to 159,186. The figures in Birmingham are slightly down, the total of unemployed in the city being 22,782. Increases were recorded at Stoke-on-Trent, Derby, Dudley, Leicester, Northampton, Nottingham, Peterborough, Redditch, Wolverhampton, and Worcester.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Welcome Spurt.

An improvement in November exports of textile machinery to the extent of £215,000 compared with October, in spite of the fact that the former was a shorter working month, has done much to make reasonably certain that the total for the year will be at least equal to, if it does not exceed, the value for 1928. A decline in weaving machinery during the month under review was more than made good by a substantial improvement in the shipments of spinning and twisting machinery. The exports of the latter class amounted to 9479 tons, valued at £833,459, compared with 8392 tons and £733,563 a year ago, and of weaving machinery to 1854 tons and £145,999, against 2717 tons and £179,377, the total of all descriptions, including miscellaneous plant for the textile industries, being 11,746 tons, valued at £1,052,933, compared with 11,871 tons and £1,001,650 in the corresponding month of 1928. Although India continues well in the lead as a market for British plant of this class, there has been a remarkable improvement in the takings of China, with Russia well at the bottom of the list. Shipments to British India were valued at £320,568, with China second with £117,978, followed by Japan, £93,535; France, £68,098; Germany, £50,352; the United States, £50,195; South America, £42,033; the Netherlands, £31,752; Australia, £26,000, and Russia, £3658, "other European countries" taking the formidable aggregate of £194,431.

Crewe's Hundredth Locomotive.

The hundredth locomotive to be completed this year at the Crewe works of the London, Midland and Scottish Railway Company was turned out on Monday of this week, the aggregate tonnage of 5550 constituting a record. This rate of construction—an average of two a week—is made possible by the installation at a cost of £750,000 of plant working on the American belt principle. It is reported that orders have been received for a further 75 engines, which are expected to be completed early next summer.

Morecambe's £130,000 Coast Road.

Morecambe Corporation has secured the sanction of the Ministry of Transport to make an immediate start with the construction of a new coast road at an estimated cost of just short of £130,000, and the first sod was formally cut by Lord Derby on Thursday of this week. The Ministry is to bear the cost of 75 per cent. of the scheme, and the Lancashire County Council 12½ per cent. The new road, which will take about 2 years to complete, will start at the East End promenade, Morecambe, and after passing along the shore of the bay to Hest Bank will join the London-Carlisle main road at Bolton-le-Sands.

Non-ferrous Metals.

Apart from tin, there has been little movement from the point of view of values in the non-ferrous metals market during the past week. In the section mentioned, however, there has been a further substantial recovery, and although prices have not yet reached the level of those ruling towards the end of last month, they are not very far behind. To a large extent, of course, the improvement may be directly attributed to the recommendation just made to its members by the Tin Producers' Association with a view to the limitation of output. Less anxiety to force supplies on to the market has been in evidence, and on the whole the turnover in the metal has been about up to the level of the previous week. The net result of the improvement has been a gain in values of about £5 a ton on balance for the week. Although fractionally lower compared with last report, the tone in the copper section has been reasonably steady and a moderate amount of buying interest has been displayed. Spelter seems to be unable to extricate itself from the depression which has overshadowed it during the second half of this year, and there has been a further slight loss on balance, with the demand on quiet lines. There has been little change in the position of lead, which, however, appears to be affected by the uncertainty of spelter, and buyers show little disposition to operate with any degree of freedom.

Iron and Steel.

Interest in pig iron so far has been little affected by seasonal influences, but in all other respects the iron and steel markets this week have been inactive. A certain amount of forward buying over the first three months of next year has been reported by foundry iron makers, and there is still a persistent call for contract deliveries. Quotations are firm all round, with Derbyshire and Staffordshire descriptions at 77s. per ton for delivery in the Manchester zone, Scottish at about 95s. and West Coast hematite at 90s. per ton. Bar iron keeps steady at £10 15s. for Lancashire crown quality and £9 15s. for No. 2, but the demand locally this week has been poor. There has been little movement in the case of steel, and rollers generally report a paucity of tonnage being taken against contracts, whilst new orders have been very small indeed. The rolling mills, however, are looking forward to a bigger business in locomotive boiler plates early next year, and there is some hope of improvement in the demand from constructional engineering firms locally. From the point of view of prices, the position is much the same as before, acid and basic boiler plates being well held at about £10 per ton, joists at £8 2s. 6d., tank plates at £8 17s. 6d., large bars at £9 2s. 6d., and small re-rolled bars at £8 5s. to £8 7s. 6d. Prices of continental steel materials are uncertain in tendency, and orders being booked on this market continue to be for relatively limited quantities.

BARROW-IN-FURNESS.

Hematite.

There is little fresh to report on the hematite pig iron market, which continues to be fairly steady with deliveries at such a tonnage as to allow of little or no stock accumulating. Business may quieten down during the holidays, as it usually does, but all signs point to a general continuance of present demands. In the special qualities there is a firm trade, and America and the Continent are both customers for iron of stated analysis. The local ore mines are steadily engaged and the local demand is maintained. Outside business continues satisfactory. The demand for foreign ore is steady and there has been a slight easing in price of Spanish and other ores. The steel trade is only moderate. A certain tonnage of rails has been turned out on Argentine account, and orders have been received for some rails which are included in the L.N.E.R. 45,000 tons requirements.

Shipbuilding.

There are plenty of rumours regarding new shipbuilding contracts, but up to the present there has been no official announcement and until that is made it is advisable to be guarded on the subject. It seems certain that fresh contracts are coming to Barrow shortly, and news about them should be known by the New Year.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trades.

THERE is little change to report in the condition of the various branches of the steel trade, but such movements as exist are mostly in a downward direction. This, however, is thought to be due to holiday influences. Whether the situation is really going forward or backward cannot be judged from present indications, and it will not be possible to pronounce a definite opinion until the New Year opens. The heavy branches report a scarcity of substantial inquiries, and they are not assured of orders to replace those which are in course of execution. Basic steel continues in good demand, and this department has more than held its own during the year; but the demand for acid qualities has shown a considerable decline during

the twelve months. The departments working for the railway companies, in the production of axles, tires, and springs, are far from fully employed, although their output during the present quarter has shown some advance as compared with recent averages. It is declared that prices of raw and semi-steel for general consumption are unremunerative, in spite of the relief afforded to manufacturers by the Derating Act.

Railway Orders.

Some substantial orders for railway rails and sleepers have been given out during the past week, and the Sheffield district gets a share of them. The London and North-Eastern Railway Company is buying 47,000 tons of steel rails, the orders for which have been divided among nine firms, including the English Steel Corporation, Sheffield, and Samual Fox and Co., Ltd., a branch of the United Steel Companies, Stockbridge. The same company has also ordered 16,000 steel sleepers, a portion of which are to be made by the United Steel Companies. Other railway companies are ordering steel sleepers in large quantities, from firms in various parts of the country, and the increasing interest which is being displayed in this form of track support is of much promise to Sheffield. Tenders have been sent in from Sheffield for 300 steel axles required by the India Store Department. The Madras and Southern Mahratta Railway has invited tenders for 400 steel axles for carriages and wagons, and the Bengal-Nagpur Railway is in the market for 1450 carriage and wagon tires.

Special Branches.

The busiest branches of the Sheffield steel trade are still those of a special character, but some of them are feeling the effects of the approaching holidays, and are not booking their usual quantities of business. In all directions buyers are reducing deliveries, but they will probably resume on a normal basis after the turn of the year. A large amount of work is being placed by the electrical industry, but in this branch Sheffield has to meet keen foreign competition. The makers of automobiles continue to be large buyers of stampings and special steel from Sheffield. Requirements in this direction keep up very well so far as heavy commercial vehicles and omnibuses are concerned, but there is a falling off in the demands for light cars. Perhaps the fear that the McKenna Duties may be repealed has something to do with this fact. The cold-rolled steel and strip department, although busy, is one of those which are feeling a seasonal falling off, and the same is true of stainless steels. There is a moderate demand for best tool steels, special steels, forgings and castings.

At Redbourn Hill.

One of the features of the year has been the re-starting of the Redbourn Hill Works, Lincolnshire, belonging to Richard Thomas and Co., steel and tin-plate manufacturers. These works resumed operations at mid-summer, after being closed several years. The directors' report shows that the works gradually increased the extent of their operations, but did not attain an economic output until after the close of the financial year. The accounts include a considerable loss at Redbourn while the works were in partial operation during reconstruction, but the directors regard the results now being obtained with satisfaction and do not anticipate any further loss on the plant during the coming year.

Stainless Steel for Aircraft.

One of the constantly developing Sheffield trades is that of stainless steel, for which, as I have frequently reported, many new uses are being found. This material is now being applied to aircraft, in the construction of which it is to some extent replacing aluminium. It is reported that methods of building the hulls of flying boats entirely of stainless steel have now been evolved by British steelmakers and flying boat designers. During a 20,000 miles formation flight by a fleet of flying boats from Britain to Australia and China, it was found that aluminium alloy hulls were corroded by the action of sea water. It is claimed that the new stainless hull overcomes this difficulty. A new type of stainless steel has been produced which can be rolled into very thin sheets of great strength, and by its use flying boats of stainless steel can be built which are as light as those constructed of aluminium alloy.

Cutlery and Plate.

The Christmas season trade in the cutlery and plate branches has been shorter than last year's, but more active. Even apart from the huge orders placed for coupon and advertising goods, the output has shown an increase. Deliveries of raw material to the works in respect of this special demand have now come to an end, but the factories are still fairly well employed in finishing orders and dispatching them. The amount of trade done through ordinary shopkeeping channels is not satisfactory, but this season has shown an improvement on last. Some firms which make high-class cutlery report favourably on the season. The sales of ivory-handled cutlery, alike to the public and to the shipping companies, have exceeded the volume of recent years, and there has also been an improvement in the demand for sterling silverware. This pleasing report with regard to turnover cannot, however, be carried on to the financial side of the businesses. There are many complaints that firms have been unable to make a profit in consequence of severe competition and low prices. This, however, does not apply all round.

Exports and Imports.

There was a considerable falling off in the exports of cutlery during November, the month's total value of £108,980 being £12,000 less than that of October, and nearly the same amount down as compared with November last year. A feature of the return was a rather sharp drop in safety razors and blades, especially to the United States. Taking the eleven months of this year as a whole, the overseas trade in cutlery was of nearly the same value as last year. Imports show a considerable increase. In November, as compared with October, there was a jump from £56,325 to £83,624. The figure for the eleven months shows an increase of £260,000, as compared with 1928, and of £300,000 on 1927. In the case of implements and tools, the export figures for November showed a decline of £15,000, as compared with October, and £22,000 as compared with November last year, but here, again, the figures for the eleven months show little variation from 1928 or from 1927. There is the same story to tell, however, of increasing imports, and the eleven months show an advance on the corresponding period.

Hull Level Crossings.

The question of the abolition of the level crossings in Hull—a scheme that will involve an expenditure of something like £1,200,000—is in a somewhat uncertain stage at present. The Hull City Council is willing to approve the scheme, but does not feel inclined to face the burden of the expenditure as the matter now stands. It is asking the Government to give further assistance than that already promised by transferring the scheme from the Unemployment Grants Committee to the Road Fund. With this object, a deputation has waited upon the Lord Privy Seal and the Minister of Transport. The delegates were informed that, in the view of the law officers of the Crown, the Government could not legally treat the scheme as one to be assisted from the Road Fund, as it involved substantial expenditure on railway works. It was eventually suggested that the Corporation and the Ministry of Transport should meet in order to decide which items of expenditure would be on purely road works, so that the Minister might give sympathetic consideration to those items ranking for grant from the Road Fund.

Gas Extensions.

The Gas Committee of Bradford Corporation has decided to install a water-gas plant at its Valley-road works, to augment the supply in case of emergency. The plant is expected to produce 2,000,000 cubic feet per day, and the estimated cost of plant and buildings is about £18,000. Mansfield Town Council has decided on the reconstruction of its gasworks, provided the Unemployment Grants Committee will grant half the cost, which it is thought it will. The estimated cost is £24,600. At a district conference of the British Commercial Gas Association, in Huddersfield last week, it was stated that Sheffield was the highest of all towns in Yorkshire in the consumption of gas per head of the inhabitants, and that practically 50 per cent. of the gas used in the city was applied to industrial purposes.

Coal Winding Record.

The Frickley Colliery, one of the group owned by the Carlton Main Colliery Company, established a new winding record last week, when 6197 tons 19 cwt. were drawn from one shaft in fifteen hours' winding time, from which has to be deducted 40 minutes' snap time. The previous record for the colliery was 6004 tons 11 cwt., drawn on March 26th last.

NORTH OF ENGLAND.

(From our own Correspondent.)

Tees Dock Scheme Abandoned.

MUCH regret has been expressed by shipowners and Tees-side industrialists at the news that the London and North-Eastern Railway Company has abandoned the project to build a deep-water dock near the mouth of the River Tees. An agitation has been going on for many years for increased dock facilities on the Tees, as the existing dock has been found to be inadequate to requirements. There has not only been great congestion, but vessels have been kept waiting in the river or Tees Bay awaiting a berth, and as a result shipowners and manufacturers have been involved in extra charges. Some years ago the railway company acquired a large area of land on the Yorkshire bank of the Tees with the intention of constructing a new dock. Plans were prepared, but when the trade depression came along the scheme was shelved. Now the railway company has definitely dropped the project. There is no doubt that the trade at the port has been badly handicapped by the lack of proper docking facilities, and it is interesting to note that a committee representing the Chamber of Shipping, the Association of British Chambers of Commerce and the Federation of British Industries, in a report which is to be presented to the Government, recommends that a sound dock scheme is urgently required on the Tees. Shipowners and industrialists are agreed that the Tees is far behind other ports as regards her dock, which is out of date. The dock, designed to accommodate steamers of 5000 to 6000 tons, must now serve steamers of 10,000 to 12,000 tons. The committee, in its report, says that while it recognises the financial consideration which might make the London and North-Eastern Railway Company, which owns the dock, hesitate to embark on the necessary expenditure, it can see no justification for refusal to provide the facilities required if the Government is ready to assist.

Cleveland Iron Trade.

The Cleveland iron market has worn a very quiet appearance throughout the week. The holidays being so close at hand buying has ceased, consumers being well aware that after the holidays there is bound to be an accumulation of pig iron at producers' works. The steel works after all are the biggest consumers of pig iron, and as they will be idle over Christmas, all the iron produced during that period, which would have normally gone in a molten state into the steel furnaces, will have to go into stock. Thus supplies of pig iron are likely to be plentiful for at least a few weeks to come, and buyers are secure in the knowledge that they can delay purchases. Cheaper coke has slightly reduced the cost of production, but the relief is too light to have any effect on prices, which are all unchanged, No. 1 Cleveland foundry being 75s., No. 3 G.M.B. 72s. 6d., No. 4 foundry 71s. 6d., and No. 4 forge 71s.

Hematite Pig Iron.

A firm tone characterises the East Coast hematite pig iron trade, and further advance in prices is expected. Producers report that they have sold their output about as far ahead as they care to commit themselves. Home consumers are expected to enter into further substantial contracts after the holidays, and inquiries from overseas encourage hope of repeat orders from firms abroad, despite the fact that foreign hematite is offered freely in continental markets at considerably below rates ruling for the products of this district. Prompt lots of East Coast brands are obtainable from second hands at 79s., but makers are securing up to 81s. for delivery to the end of next quarter. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Business in the foreign ore trade still continues on quiet lines. Spot cargoes are stated to be obtainable at below figures generally named recently, but it is difficult to ascertain on what terms lengthy contracts might be renewed. Fall in freights has assisted materially to weaken the market. The nominal price of best Rubio ore cannot be put at more than 24s. c.i.f. Tees. The reduced demand for blast-furnace coke keeps quotations for that commodity easy. Good average qualities are on sale at 23s. delivered at the works.

Manufactured Iron and Steel.

A decided impetus has been given to the steel trade of this area as the result of the placing of orders for steel rails by the London, Midland and Scottish Railway Company with three Tees-side firms. The orders amount in aggregate value to nearly £100,000, and have been given out to Dorman, Long and Co., Ltd., the Cargo Fleet Iron Company, Ltd., and Pease and Partners, Ltd. This new work follows upon several orders for rails which have been booked by Tees-side firms during the past two or three months, and the cumulative effect is that there will be active employment at the rolling mills for some months ahead. An encouraging feature is that the orders have been secured in face of keen continental competition, though there is no doubt that British railways prefer the steel rails produced in this country to those made abroad. Users of other descriptions of heavy steel are also accepting large supplies. Deliveries of shipbuilding requisites, bridge building material, and plates are also on a large scale. Orders for semi-finished steel are difficult to secure in face of the increased continental competition, but firms in this district have still much work to execute and are slow to lower quotations. Manufactured iron producers are turning out heavy tonnage. Finished iron and steel prices are unchanged all round.

The Coal Trade.

The collieries in Northumberland and Durham have been working to capacity this week to clear off orders they have in hand, which have accumulated recently owing to the delayed shipping movements. Tonnage is moving more freely now, but there is still room for improvement in that direction and some pits are in need of prompt boats. In Durham, a shortage of wagons is aggravating the position of some collieries, which are having to put coal on the ground. Northumberland steam coals are very firm and scarce to the end of the year, and current prices will probably mark the opening weeks of next year. There is not much coal in second hands, and values by contractors are being barely shaded, as there is plenty of prompt business about. Best steams are quoted at 17s. 6d. for prompt and difficult to discount for all January at this figure. Best Durham steam coal is practically out of the market, but quotations are unchanged at 18s. 6d. for large and 14s. 6d. for small. Gas coals have been hampered for wagons and tonnage, but the position is improving. Best qualities are at 17s. and seconds at 15s. 3d. to 15s. 9d. Bunker coals are firmer, and may be scarce under a growing demand. Ordinary kinds are well held at 15s. 6d. to 15s. 9d., and the top grades are indicating full strength at 16s. 6d. to 17s. 3d. The prospect of more tonnage will be helpful to the patent foundry coke export trade, the recent absence of it having caused an increase of prompt supplies at easier figures. The home market in blast-furnace coke is lacking in strength owing to the fewer furnaces in operation. Gas cokes are well sold, and prices are very firm.

SCOTLAND.

(From our own Correspondent.)

Conditions Unchanged.

THERE has been no change of importance in the steel, iron and coal trades during the past week. Business is more or less finished for the year, and apart perhaps from certain descriptions of coal, there has been no pressure for supplies over the New Year holidays, nor is there any indication of an early improvement in the steel and iron trades. There has at times been a greater feeling of confidence, owing to an expectation of an improvement in the shipbuilding industry, and in anticipation of considerable orders for railway materials, but so far there has been no direct evidence that these hopes may be realised. The outlook on the whole therefore is dull.

Steel.

Business in steel has been a shade quieter during the past week, owing to a disposition on the part of consumers to take lighter deliveries in view of stock-taking during the New Year holidays. At the moment, some difficulty is experienced in keeping plants moving at full strength. So far as steel sheets are concerned, the lighter gauges continue in better demand than the heavy descriptions. Galvanised sheets have a better demand, but prices have as a rule to be cut keenly. Tube makers

are busy in most departments, and report an improvement in butt-welded descriptions, which have been quiet for some time.

Iron.

Short time is the rule at the bar iron works, and it seems unlikely that there will be an early change for the better. The demand for re-rolled steel is adversely affected by the low prices quoted for continental products, and for any business offered, makers have difficulty in securing the quoted price of £7 15s. per ton, home or export.

Advance in Pig Iron.

The demand for pig iron continues quiet, though perhaps steady. Minimum prices have been advanced 1s. per ton in the case of hematite, and 2s. per ton for foundry qualities, making maximum quotations as follows:—Hematite, 81s.; No. 1 foundry, 80s. 6d.; No. 3 foundry, 78s.—all per ton for home delivery.

Cheaper Scrap.

Scrap materials have become more plentiful, and prices have eased to 71s. per ton for heavy steel and 69s. per ton for heavy basic and cast iron machinery descriptions.

Coal.

While the home branch of the trade is quieter than is usual at this time of the year, the drop in turnover is not seriously felt, as most of the collieries have fairly heavy shipments to make before the year closes. The work at the ports has been interfered with owing to the non-arrival of boats delayed by heavy weather. The docks hold an accumulation of loaded wagons and, consequently, there is a scarcity of empty trucks at colliery sidings. All districts are busy. The collieries in Fifeshire are particularly active, and may not be able to undertake all their commitments before the New Year holidays begin. Aggregate shipments during the past week amounted to 217,064 tons, against 304,471 tons in the preceding week, and 243,067 tons in the same week last year. Business for delivery in the New Year has been most restricted, especially since the various schemes for the reorganisation of the industry became known. Neither collieries nor importers show the least inclination to contract ahead, and forward business, therefore, is practically at a standstill.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE expected has happened regarding the tonnage position, inasmuch as the docks are congested. It was fully anticipated that when the gales subsided steamers which have been long delayed would arrive together, and most collieries, instead of experiencing difficulty in finding an outlet for their production, would be short of the necessary supplies to give steamers quick dispatch. There is no doubt that many vessels now in dock will be days before even getting into berth and that probably a good percentage will be unable to complete the loading of their cargoes before the holidays. At the end of last week the position was that close on fifty loading appliances were idle owing to tonnage being held up, but over the week-end heavy arrivals took place as the result of a moderation of the weather, and on Monday there were thirty-four steamers waiting at the various docks. Many other steamers are due to arrive before the vacation, and it is therefore not surprising that colliery stems are so congested that tonnage offered for employment immediately before and after the holidays is meeting with difficulty in finding charterers and that outward rates of freight are for most directions depressed. In fact, during the last week or so the outward rate of freight to West Italy has touched 7s., the lowest record for the year, while a steamer has been fixed for Venice at the exceptionally low figure of 9s. 3d. It is years since the market for this port was so low for chartering during the month of December. Usually the freight market has taken a decided turn towards improvement when October and November come round, but this year the reverse has been the case. There is no doubt that collieries will have a busy time right up to the end of the year and the early part of January. As regards contract operations, confirmation has now been received that the Egyptian State Railways have placed their order for 165,000 metric tons of locomotive coals for delivery at Alexandria during the next four months with T. Beynon and Co., Ltd., at the price of 28s. 4½d. per ton, so that the Monmouthshire colliery undertakings will benefit. The Andalucian Railways of Spain are in the market for round about 30,000 tons of steam coals to be delivered at various Spanish ports over the next six months.

Coal Combines.

Reference was made recently to the proposed scheme for bringing about a dozen colliery concerns and a leading coal exporting undertaking under one control, to be known as Welsh Associated Collieries, Ltd. Since then shareholders in Gueret, Llewellyn and Merrett, Ltd., the exporting undertaking in question, have received a circular stating that assents have been received from shareholders who hold more than 90 per cent. of the issued capital of the company, and that as a matter of fact shareholders in all the companies involved in the scheme of amalgamation have assented to a greater extent than 90 per cent. The scheme is, therefore, going forward, and the proposed new company will formally be incorporated in the near future. Reports have also been current for some time, but are now taking more definite shape, that negotiations are in progress between the Powell Duffryn Steam Coal Company, Ltd., and William Cory and Son, Ltd., for the purpose of bringing about a close working arrangement. Such a proposed scheme has much to recommend it from the point of view of these two concerns, as the former undertaking possesses the collieries and the latter is well known in the coal exporting line, while both have substantial interests in the inland markets.

North Wales Coal Audit.

The North Wales coalfield audit for the three months ended October shows a credit balance of £4573, which is equal to 1·22d. per ton on an output of 895,936 tons. There was a loss in August of £2520, equivalent to 2·10d. per ton, and in September of £3192, or 2·66d. per ton, but in October there was a profit of £10,285, or 7·71d. per ton. The proceeds during the three months increased from 12s. 9·96d. per ton to 13s. 1·25d. per ton, and averaged for the three months 12s. 11·13d. per ton. The economic wage certified was equal to 3·22 per cent. above the basis rates, but the owners under the agreement have to pay a minimum wage rate of 22 per cent. above the basis rates. The deficiency arising from the sacrifice of the owners' share of the net proceeds amounted to £73,146. The total deficiency carried forward has, therefore, been increased to £2,872,061.

Tin-plate Items.

Tin-plate works in South Wales will be closed for the whole of Christmas week, while steel works are expected to be closed from December 24th until the following Sunday. On Monday last, about 450 men employed at the Morriston and Midland Tin-plate Works, Swansea, were on strike. The stoppage, which concerned mainly the mill department, is stated to have been entirely without official sanction and was in the nature of a protest on the part of the men against the use of Belgian bars. It is stated that these bars cause the men undue hardship and decrease their output, but this is denied by an official of the firm.

Current Business.

The steam coal market is more nominal than anything else for the reason that prompt business is practically at a standstill. Collieries have such heavy commitments for early loading that they have scarcely any coal to offer. The market is steady for large coals of all descriptions, but dry qualities are very firm. Small coals and sized qualities are unobtainable for prompt shipment. Patent fuel and coke are also fully sold. Pitwood is steady at round about 29s.

LAUNCHES AND TRIAL TRIPS.

BRIMANGER, motor vessel; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Westfal-Larsen and Co. A/S, Bergen; dimensions, 415ft. by 54ft. 6in.; to carry 8500 tons cargo. Engines, Diesels; constructed by J. G. Kincaid and Co., Greenock; trial trip, November 12th.

KUFRA, single-screw motor vessel; built by Harland and Wolff, Ltd., to the order of Moss Line, Ltd.; dimensions, 330ft. by 47ft. by 30ft. 3in.; to carry cargo. Engines, single-acting Harland-B. and W. type, developing 2050 B.H.P.; constructed by the builders; handed over to owners, November 16th.

JO TAYLOR, single-screw steamer; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Eros Steamships, Ltd.; dimensions, 407ft. by 53ft. 9¾in. by 36ft. 3in.; to carry cargo. Engines, triple-expansion, 26in., 43in., 72in. by 48in. stroke, pressure 180 lb. per square inch; constructed by the builders; launch, November 18th.

TRALUN, steel light vessel; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of the Government of India; dimensions, 114ft. by 24ft. 6in. by 15ft.; launch, November 18th.

CRAWFORD ELLIS, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Hav Company, of Oslo; dimensions, 290ft. by 40ft. by 25½ft.; to carry fruit. Engines, triple-expansion; constructed by the builders; launch, November 19th.

RANCAGUA, twin-screw oil tanker; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of the Chilian Government; dimensions, 378ft. by 49ft. 9in. by 27ft. 3in.; to carry bulk oil. Engines, triple-expansion, 23½in., 38in., 64in. by 42in. stroke, pressure 180 lb. per square inch; constructed by the builders; launch, November 19th.

WINCHESTER CASTLE, motor vessel; built by Harland and Wolff, Ltd., to the order of Union Castle Mail Steamship Company, Ltd.; dimensions, 630ft. by 75ft. by 44ft. 6in.; to carry passengers. Engines, two eight-cylinder double-acting four-stroke motor engines of the Harland-B. and W. type; constructed by the builders; launch, November 19th.

MARKLAND, twin-screw steamer; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of Mersey Shipping Company, Ltd.; dimensions, 338ft. by 53ft. by 30ft.; to carry paper. Engines, triple-expansion, 16in., 27in. and 44in. by 33in. stroke; constructed by the builders; launch, November 20th.

WILL CROOKS, paddle-wheel ferry steamer; built by J. Samuel White and Co., Ltd., to the order of the London County Council; dimensions, 171ft. 7in. by 62ft. by 7ft. 6in.; to carry passengers and vehicles. Engines, two independent sets simple condensing engines, pressure 50 lb. per square inch; launch, November 20th.

CATALOGUES.

SULZER BROS., 31, Bedford-square, London, W.C. 1.—A list of Sulzer-engined motor ships.

ACCLES AND POLLOCK, Ltd., Oldbury, Birmingham.—A booklet entitled "Make it with Tubes."

H. AND T. DANKS (NETHERTON), Ltd., Netherton, Dudley.—A brochure on "Danks-Netherton" water-tube boilers.

MIDLAND ELECTRIC MANUFACTURING COMPANY, Ltd., Birmingham.—An illustrated list of switch and fuse gear.

TANGYES LTD., Cornwall Works, Birmingham.—List No. 373, describing the new design two-stroke vertical fuel oil engine.

PETER BROTHERHOOD, Ltd., Peterborough.—Publication W.C. 29, describing in some detail Brotherhood water cooling plant.

MORSE CHAIN COMPANY, Ltd., Letchworth, Herts.—Handbook ML929 of standardised Morse chain drives.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Catalogue 1002 of "Monogram" and other cast iron fans.

BRITISH BROWN-BOVERI, Ltd., Trafalgar House, Waterloo-place, London, S.W. 1.—A booklet dealing with electric drive for machine tools.

EDWARD BENNIS AND CO., Ltd., 28, Victoria-street, S.W. 1.—Particulars of the firm's new bar chain grate and the "Bennis" pulverised fuel system.

BRITISH MANNESMANN TUBE COMPANY, Ltd., 67, Queen Victoria-street, E.C. 4.—Catalogues on "Weldless Steel Mains" and "Lapwelded Steel Pipes."

ENGLISH STEEL CORPORATION, Ltd., Vickers House, Broadway, S.W. 1.—Catalogue Section H, describing in detail the firm's 300ft. portable drilling rig.

J. MULOCH, Broadway-buildings, London, S.W. 1.—A leaflet describing the "Panalumin" process for the protection of aluminium against corrosion.

PATENT LIGHTNING CRUSHER COMPANY, Ltd., 14A, Rosebery-avenue, E.C. 1.—Details of the patent crusher and granulator and some particulars of its work.

EDGAR ALLEN AND CO., Ltd., Imperial Steel Works, Sheffield.—"Special Alloy Tool Steels" and "Maxhete, the Steel that Resists Heat and Corrosion."

SILICA COKE OVEN AND MACHINERY, Ltd., Aldwych House, Aldwych, W.C. 2.—Bulletin No. 4 describing the Derwenthaugh Coke Works of the Consett Iron Company.

BRITISH ARCA PATENT REGULATORS, Windsor House, Victoria-street, S.W. 1.—A booklet on automatic regulators for pressure, temperature, humidity, volume, vacuum, &c.

GASIFIED PULVERISED FUEL (G.P.F.), Ltd., 4-5, Norfolk-street, Strand, W.C. 2.—Leaflets on pulverised fuel for ships, collieries, power stations and various industrial purposes.

NEW DISTRIBUTORS OF EDISON STORAGE BATTERIES, Ltd., Victoria House, Southampton-row, W.C. 1.—Copies of booklets dealing with batteries for commercial vehicles, locomotives, coaches, ships, &c.

J. DOWNHAM AND CO. (1927), Ltd., Barnbrook Ironworks, Bury.—A list of the firm's products, which include bleaching, dyeing and finishing machinery for textiles; rollers and machinery for leatherettes, book back and rubber cloths and tarpaulins.

LEA RECORDER COMPANY, Ltd., 28, Deansgate, Manchester.—Pamphlets: C.B.M. 13, "The Lea 'Cubi-Meter' for Measuring Coal and other Materials in Bulk"; Q. 16, "Measurement of Water and other Liquids over Weirs and Notches in connection with Mining Work"; Q. 19, "Gauging of Streams, Rivers, Sewage, &c., with special reference to Widely Fluctuating Flows over Compound and Stepped Weirs."

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DU CROO AND BRAUNS, Ltd., ask us to announce that on and after December 27th next their address will be changed from 196, The Grove, Hammersmith, W. 6, to 96/98, Leadenhall-street, London, E.C. 3. Telephone, Avenue 6067; telegrams, "Ducrobra, Fen, London."

VELTENE Ltd. asks us to announce that it has altered its address from 29, Mincing-lane, London, E.C. 3, to new offices at its factory: 34, Priory-grove, London, S.W. 8, Telephone No. Brixton 5385, to which it is requested that all communications should in future be addressed.

CONTRACTS.

THE GENERAL ELECTRIC COMPANY has received an order for 3800 Osram lamps for station lighting on the Mersey Railway.

RUSTON AND HORNSBY, Ltd., of Lincoln, have received instructions to put in hand nine Ruston marine auxiliary oil engine generating sets, each of 306 kW, to be installed—three sets per vessel—on board three motor cargo liners to be built for the New Zealand Shipping Company, Ltd.

THE PARSONS OIL ENGINE COMPANY, Ltd., of Southampton, has received from the London County Council an order for two T6M Parsons marine sets of the paraffin type, to replace the present machinery in the Thames fire float "Gamma II." These engines are each to be of 85 H.P. at 750 r.p.m., and will be coupled to existing pumps and stern gears.

HENRY SIMON, Ltd., of Manchester, has received from the Magasins a Grains d'Anvers an order for a travelling pneumatic grain plant for discharging grain ships and barges at Antwerp docks. The plant is to have a handling capacity of 90 tons per hour, and will be provided with two booms carrying flexible telescopic pneumatic intake pipes. All the machinery is to be mounted on a travelling steel tower, which is to be provided with jacks so that the bogies can be turned through 90 deg., and thus enable the plant to be traversed along another quay lying at right angles. The exhauster will be of the turbo type, and the grain will be delivered to a 2-ton weigher in the tower and then transferred automatically either to an existing band conveyor in the quay or to barges., railway wagons or road vehicles.

REVVO CASTORS.—In our description of the Revvo castor in our last issue it was referred to as the Revo. As the latter word is the registered name of another invention, we have been asked to call attention to the correct spelling.

SECOND WORLD POWER CONFERENCE, BERLIN, 1930.—The recently published form of application for participation in the Second World Power Conference, which is to be held in Berlin in 1930, gives a summary of the numerous scientific and social arrangements which have been planned in connection with this great international congress, at which the power specialists from all parts of the world will meet in the German capital next June. In addition to the scientific discussions on the different technical subjects, there will be a Reception in the Reichstag, an opening ceremony in the auditorium of the Kroll Opera House, a great world power festival, and a number of informal meetings of the participants. At present the list of works to be visited numbers about two hundred. About half of these are power stations and gasworks, and the other half are energy-consuming enterprises, such as coal mines and steel works, chemical works, factories which manufacture electric machines, steam turbines and internal combustion engines, shipbuilding yards, wireless stations, and so on. The seven different itineraries, which radiate in all directions from Berlin, take in the immediate environs of the capital, the industrial centres of the Rhineland and Westphalia, Baden, Bavaria, Upper Silesia, Pomerania, and East Prussia, and the Hanseatic towns of Bremen, Hamburg, and Lübeck. Forms of application for membership, giving all the information necessary, can be obtained from the Executive Committee of the Second World Power Conference, Berlin, N.W. 7, Ingenieurhaus.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/–
(1) Spanish	23/– to 24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 1 0	—
No. 1 Foundry	4 0 6	—
No. 3 Foundry	3 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 19 0	3 19 0
No. 1	3 19 6	3 19 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (*a*); 4 9 6 (*b*); 4 13 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 2 6	12 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 2 6 to 8 15 0	—
Billets and Sheet Bars	6 5 0 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	12 10 0 to 13 0 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/9 to 19/–
Block Tin (cash)	186 0 0
„ (three months)	189 5 0
Copper (cash)	68 10 0
„ (three months)	67 10 0
Spanish Lead (cash)	21 7 6
„ „ (three months)	21 10 0
Spelter (cash)	20 1 3
„ (three months)	20 11 3
MANCHESTER—	
Copper, Best Selected Ingots	76 10 0
„ Electrolytic	83 15 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	22 17 6
„ Foreign	21 12 6
Spelter	20 17 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit
Tungsten Metal Powder	3/4½ per lb.	
Ferro Tungsten	3/1½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£22 0 0	6/6
„ „ 8 p.c. to 10 p.c.	£21 17 6	6/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/–
„ „ „ 1 p.c. carbon	£39 0 0	15/–
„ „ „ 0·70 p.c. carbon	£41 0 0	15/–
„ „ „ carbon free	1/– per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0	scale 5/– per unit
„ „ 75 p.c.	£19 0 0	scale 7/– per unit
„ Vanadium	12/10 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
„ „ Ell	16/6
„ „ Splint	16/9 to 18/–
„ „ Trebles	17/6
„ „ Doubles	17/–
„ „ Singles	14/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/6
„ „ Jewel	17/6
„ „ Trebles	17/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	15/– to 16/6
Screened Navigation	18/– to 19/6
Trebles	18/6 to 19/6
Doubles	17/– to 17/6
Singles	15/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/–
Secondary Steam	14/3
Trebles	18/–
Doubles	16/6
Singles	14/9

ENGLAND.

(8) N.W. COAST—	
Steams	21/6 to 23/–
Household	38/– to 51/–
Coke	27/6
NORTHUMBERLAND—	
Best Steams	17/3 to 17/6
Second Steams	16/–
Steam Smalls	11/3
Unscreened	13/– to 13/6
Household	25/– to 37/–
DURHAM—	
Best Gas	17/–
Second	15/3 to 15/6
Household	25/– to 37/–
Foundry Coke	25/– to 30/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	26/6 to 28/– —
Derbyshire Best Bright House	21/– to 23/– —
Best House Coal	20/6 to 21/6 —
Screened House Coal	18/6 to 20/– —
„ „ Nuts	16/6 to 18/– —
Yorkshire Hards	15/6 to 17/– —
Derbyshire Hards	15/6 to 17/– —
Rough Slacks	9/– to 10/– —
Nutty Slacks	7/6 to 8/6 —
Smalls	3/– to 5/– —
Blast-furnace Coke (Inland)	16/– to 17/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	24/– to 24/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/– to 20/3
Second Smokeless Large	18/9 to 20/–
Best Dry Large	20/6 to 21/–
Ordinary Dry Large	20/– to 20/6
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/9 to 18/3
Ordinary Eastern Valley Large	17/6 to 17/9
Best Steam Smalls	14/3 to 14/9
Ordinary Smalls	13/– to 14/–
Washed Nuts	19/6 to 32/6
No. 3 Rhondda Large	20/3 to 21/–
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/3 to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	14/3 to 14/9
Foundry Coke (Export)	32/6 to 37/6
Furnace Coke (Export)	30/– to 32/6
Patent Fuel	22/– to 22/6
Pitwood (ex ship)	29/– to 30/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/–
Seconds	30/– to 32/6
Red Vein	26/– to 28/–
Machine-made Cobbles	43/6 to 45/6
Nuts	45/– to 47/6
Beans	28/– to 30/–
Peas	20/– to 20/6
Breaker Duff	10/6 to 11/–
Rubbly Culm	13/3 to 13/9
Steam Coals:	
Large	18/– to 19/–
Seconds	17/– to 18/–
Smalls	13/– to 14/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Price Maintenance.

STEEL and other producers are endeavouring to unravel a somewhat complicated situation, which may be cleared up by a renewal of the Cartel under conditions that will ensure an adjustment of prices for export, but the preliminary meetings at Liége, Düsseldorf, and elsewhere are leaving the outlook so obscure that makers are obliged to do their best to bring about some order in the steel trade. The fixing unofficially of minimum prices for export has not so far had the desired effect of reviving business. It is known that concessions on these prices are made for large orders. Another disquieting feature for continental steel makers is the operation of the British Steel Export Association, which, it is feared, will develop into a competitor of the Steel Cartel. Judging from inquiries, there is a good deal of business available at former prices, which producers are not in a position to accept, and everything points to prices rising still further. In the engineering trades there continues to be fair employment, and the machine tool firms have been doing well, while additional orders are reported to have been placed in Great Britain for special types of machines required by motor car manufacturers. About two months ago there was a sudden cessation of activity in the motor car industry which has continued to slow down, and is now remaining in expectation of a recovery. Meanwhile, nearly all the firms are giving attention more particularly to commercial vehicles. It hardly seems likely that the home market for touring cars will expand unless prices are reduced, and if that is done manufacturers will be less able to compete for foreign trade. In some other branches of the engineering industries, the outlook is promising, particularly in electrical engineering and in the locomotive and wagon-building shops. The programme for the coming year, prepared by the Conseil Supérieur des Chemins de Fer, provides for the purchase of 15,425 coaches and wagons, as compared with 11,750 this year.

Public Works.

So long as Germany supplied plant, machinery, and material, and even labour for the carrying out of public works, in accordance with the reparations plan, there was a general activity from which all the engineering industries benefited; but, nevertheless, there was direct competition with French manufacturers who could have supplied practically everything, and it was clear that such competition would eventually have had a serious and permanent effect upon the home engineering trades. Now that the German contributions on account of reparations are to be largely reduced, the Government admits the seriousness of that competition, and hopes, with the aid of the considerable sum of money which is to be devoted to public works, to permit of the programme being continued and thereby provide employment in all branches of the engineering industries. Notwithstanding the Government's plan to spend 5000 million francs during the next five years, fears were expressed during the debate on the Estimates that some of the big undertakings would be held up, notably the port extensions at Bordeaux. Particular importance was attached to the carrying out of the inland waterway programme. The Atlantic ports have very few cross-country traffic facilities. While all efforts to render the Loire navigable have failed, the future of the ports is believed to lie in an improvement to existing canals and the construction of new ones. The scheme for making the Rhone navigable above Lyons, which would become an inland port, gives additional importance to the question of providing an efficient system of lateral canals. The State has always encouraged inland waterways development, but has been very parsimonious in its contributions towards the expense. It is difficult to estimate whether the traffic will justify the cost of constructing and maintaining canals.

Railway Acceleration.

With the object of providing increased facilities for tourist traffic, both the State Railways and the P.L.M. Company are accelerating services, and the Wagons-Lits Company is preparing to run Pullman cars similar to those used in the United States. Arrangements for improving the service between Paris and Cherbourg have not yet been completed, but the first train with the new Pullman cars ran during the week from Paris to Nice. Known as the "Cote d'Azur Pullman Express," the train was hauled by a "Mountain" type locomotive, and was driven for a part of the way by the Chief Engineer, Monsieur Vallantin. Starting from the Gare de Lyon at 8.50 a.m., it arrived at Nice at 11 p.m., or 1 h. 30 min. less than the fastest train previously running. Through the level country of the Carmague the speed indicator touched at times a shade below 82 miles an hour. The new cars are exceptionally luxurious, and a parlour car is arranged as a smoker where passengers are provided with music and reading. This is the first time that a parlour car has been run on a French railway.

Tidal Power.

The scheme for creating a tidal power installation at Aber W'rach, near Brest, has made little headway. There have been many changes in plans and in financial organisation, and it is expected now that further progress will be made as the result of the amalgamation of the two great undertakings, the Société Technique d'Etudes et d'Entreprises pour l'Industrie, which is carrying out the Aber W'rach scheme, and the Société d'Equipement des Voies Ferrées et des Grands Reseaux Electriques. The utilisation of tidal power is only one of the many undertakings which the Société Technique had in hand, and in combining their interests the two companies will develop their various schemes in association with each other. It is proposed, for example, to work out the tidal power problem as a means of providing cheap energy for electric traction. One of the schemes is to run electric locomotives with storage batteries. The first idea of putting down the Aber W'rach plant for experimental purposes has evidently not proved attractive, and some means must be found of getting a return on the capital, independently of the supply of current for lighting to Brest.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

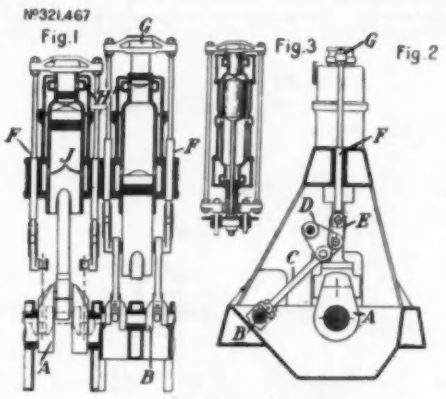
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

321,467. August 14th, 1928.—VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES, T. V. Hemmingsen, of Ove Billes, Tvaervej 4, Copenhagen, Denmark.

This invention relates to the driving of auxiliary pistons arranged over the main piston to control the opening and closing of the exhaust ports on a two-stroke internal combustion engine of the port scavenging type. In Figs. 1 and 2 the application of the invention to a two-stroke single-acting engine is illustrated, while in Fig. 3 the same idea is applied to an engine of double-acting, two-stroke design. It will be seen that parallel to the main crank shaft A there is an auxiliary crank shaft B, housed in the crank chamber, and driven by gear wheels or other suitable

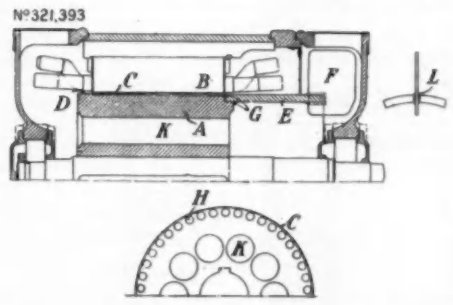


means. The connecting-rod C which is attached to the crank pin on the auxiliary shaft is coupled in turn to the bell crank lever D, which through the link E drives the guided vertical rods F. To these rods there is attached the cross head G, carrying the auxiliary piston. The exhaust ports, which are covered or uncovered by the piston, are shown at H, and the scavenge air ports are at J in the centre of the liner. A similar arrangement of driving gear with two crossheads, one for the upper and the other for the lower end of the main cylinder, is indicated in Fig. 3. The main part of the driving gear is totally enlcosed within the crank chamber, the vertical rods passing through oil-tight guides.—*November 14th*, 1929.

DYNAMOS AND MOTORS.

321,393. August 4th, 1928.—ALTERNATING-CURRENT ELECTRIC MOTORS, The Lancashire Dynamo and Motor Company, Ltd., of Trafford Park, Manchester, and John Whiteley Howard, of "Merton," 21, Sandy-lane, Stretford, Manchester.

This invention relates to alternating-current electric motors, having rotors of the squirrel cage type, so formed out of the solid that separate conductors or windings are dispensed with, and the object is to provide an improved rotor of this type with efficient ventilating means and of a construction suitable for motors in which the stresses due to the variation of load are exceptionally severe, and in which therefore robustness of the mechanical construction is of primary importance, as, for example, in motors used for driving steel rolling mills, &c.

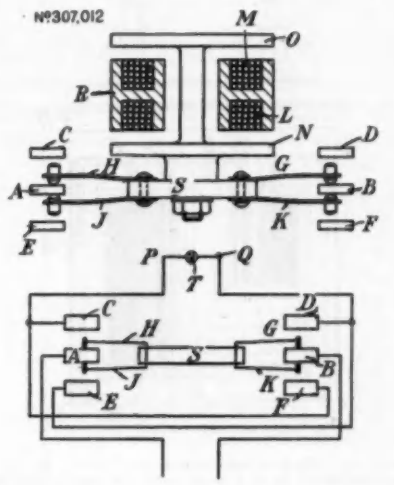


The core A is slightly longer axially than the stator core B and that portion of it which aligns with the stator core is provided with a series of suitably pitched circumferential grooves C, the portion D extending beyond the stator core, fulfilling for the left-hand end of the core the function of the end connectors of a squirrel-cage rotor, the ring E at the other end fulfilling the same purpose, and, in addition, serving to carry the fan blades F. The inner end of the ring E fits over a checked-down portion of the core, and is welded thereto, as at G. The opposite end of the ring E is slotted to take the radially disposed blades of the fan F, which are welded thereto as at L. H are longitudinal peripheral gaps which are primarily intended to ensure the necessary magnetic and electrical conditions being fulfilled, and K are longitudinal ducts primarily intended for core ventilation.—*November 4th*, 1929.

SWITCHGEAR.

307,012. January 10th, 1929.—ELECTRIC REVERSING SWITCHES, Scintilla Aktiengesellschaft, of Solothurn, Switzerland.

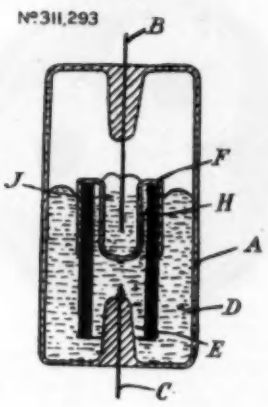
Some switches hitherto employed for reversing the direction of the current in electric installations have the disadvantage that the connections of the leads are movable; but in accordance with this invention this disadvantage is overcome. In the drawing A and B are the contacts for the incoming current, which are arranged between the contacts C D and E F for the outgoing current in parallel planes with respect to one another. S is the switch member which is actuated by the double magnet R, the resilient contact pieces H J and G K of which rest on either side against the contacts A and B for the incoming current. The contact pieces are connected together and are fixed to the switch member which is provided with two armatures N O. On the coil L of the magnet being energised, it attracts the armature N, and the contact pieces H G are pressed against the contacts C D for the outgoing current, while the contact pieces J K remain in contact with the contacts for the incoming current.



A current thus flows from A over J, H, C, the terminal P, the consuming device T, the terminal Q, and contacts D G K, to B. When the direction of the current is to be reversed, the coil M of the magnet R is energised, which attracts its armature O and moves the contact pieces J K against the contacts E F for the outgoing current, while the contact pieces H G are moved against the contacts A B for the incoming current. The current then flows in the opposite direction to the previous direction through the consumer, viz., from A over H, J, E, terminal Q, consumer T, terminal P, and contacts F K G, to B.—*November 14th*, 1929.

311,293. May 8th, 1929.—MERCURY ELECTRIC SWITCHES, Dr. Paul Meyer Aktiengesellschaft, of Lynarstrasse 5–6, Berlin, N. 39, Germany.

A mercury switch constructed in accordance with this invention is shown in the accompanying illustration. A is an outer glass tube with the two conducting leads B and C introduced at the ends of the tube. D is the mercury filling of the tube, and E a tubular-shaped, floating, iron core. The iron core carries at its upper end a vessel F of spark-proof material—for instance,



quartz. The tube H is placed firmly on the iron core, so that it must participate in all its movements. The arrangement is such that the whole of the plunging body emerges only slightly from the level of the mercury filling D. When the core is drawn into the mercury filling as by magnetic attraction, the mercury filling will rise beyond the upper edge of the floating vessel F and join up with the mercury filling J. A contact is thus brought about between two masses of mercury. When the core rises, a separation of the mercury takes place at the upper edge of the floating body F.—*November 14th*, 1929.

TRANSFORMERS AND CONVERTERS.

309,955. April 17th, 1929.—ELECTRIC TRANSFORMERS. *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

This invention relates more particularly to the insulation of high-voltage transformer windings. The electrical losses in transformers appear as heat, which must be dissipated rapidly enough to prevent excessive temperatures. The transformer shown includes a magnetic core A with a high-voltage winding B, and a low-voltage winding C, arranged concentrically with respect to each other and about the winding leg D of the core, the high-voltage winding B surrounding both the low-voltage winding and the winding leg of the core. The low-voltage winding C is insulated from the winding leg D by an insulating cylinder E. The high and low-voltage windings are separated by a cylindrical space containing a solid insulating cylinder F next to the high voltage winding and a duct G filled with an insulating fluid next to the low-voltage winding. The transformer is immersed in an insulating liquid such as oil in a casing H, so that this liquid or fluid may circulate through the duct G and along the surface of the low-voltage winding C to carry away heat and prevent excessive temperature in this winding. Solid and fluid insulations having different permitivities are thus arranged in series between the two windings, and the thickness of the solid insulation and therefore the spacing of the windings and the reactance of the transformer must be much greater than that required by the voltage across the solid insulation unless there is some provision to prevent breakdown of the fluid insulation. A layer or cylinder K of conductive material is carried by the insulating cylinder L, and is preferably embedded in it between its inner and outer surfaces. The conductive layer K is maintained at a low voltage not differing greatly from that of the low-voltage winding C, a convenient way of maintaining this low voltage being by a connection between the conductive layer K and the core A of the transformer which is usually earthed. This conductive layer M will obviously protect the

fluid insulation in the duct N from all effects of the high voltage of the winding B. The space between the high-voltage winding B and the conductive layer M is completely filled with solid insulation which need only be thick enough to withstand the voltage across it, and need not be depended upon to prevent

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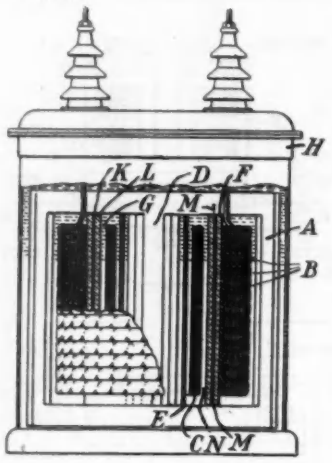

breakdown of the fluid insulation in the duct N. The presence of the conductive layer M thus permits a considerably smaller quantity of insulation to be used, so that the windings may be considerably closer together, which results in a considerably reduced reactance.—*November 14th*, 1929.

TRANSMISSION OF POWER.

319,315. February 25th, 1929.—ELECTRIC CABLES, Carl Cremer, of 70, Seestrasse, Friedrichshagen, Germany.

According to this invention, a multiple core cable is made of several intercoiled conductor cables, each provided with a metal covering, the individual conductors consisting of a single solid wire of over 10 square millimetres cross section. The total flexibility of this cable is claimed to be greater than that of the normal cable with a common lead covering enclosing all the cores. The total lead cross section is smaller than that of a normal cable with girdle insulation and a common lead covering. The resistance to bending of the lead coverings of the individual cores by reason of their considerably smaller diameter is appreciably

No 319,315

less than that of a corresponding cable with girdle insulation, and the individual insulated cores yield more readily to displacement upon each other. The flexibility is further materially assisted by reason of the fact that with a multiple core cable made of several single-core cables twisted together, the individual cores lie in plain helical paths with respect to one another. The drawing shows a cable constructed in accordance with the invention. A are the solid conductors of a three-core cable, B are the insulating layers, C the lead coverings, D the usual inner jute or bedding, E the armouring—for example, iron or steel strip or wire—and F the outer jute layer.—*November 7th*, 1929.

295,640. August 15th, 1928.—TERMINAL BOXES FOR MULTI-CORE CABLES, *International General Electric Company, Inc., of 120, Broadway, New York.*

This invention relates to distribution boxes for the ends of

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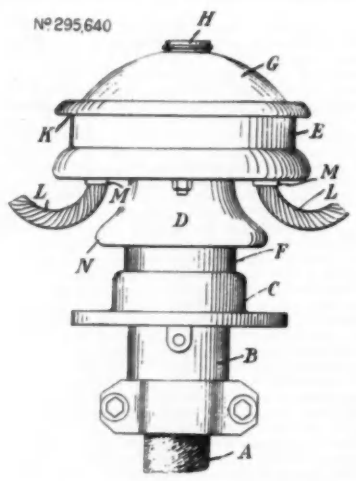


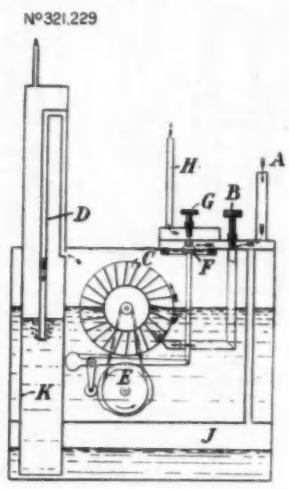
multi-core cables. Near the end of the cable A is a metal sleeve B, having at its upper end a cup-shaped portion C adapted to receive the lower end of a distribution box D of insulating material, such as porcelain. The distribution box consists of an upper cylindrical chamber E and a lower shank portion F, which fits into the cup-like projection C. The upper end of the chamber E is closed by a cap G, provided with a vent H. The cap G is held securely upon the chamber E in any suitable manner, a gasket K being inserted at the junction. Insulated liquid may be inserted through the vent H, but in the event of the cap G being loosely fitted, the vent H and gasket K will be unnecessary. The arrangement is shown as applied to a two-core cable, the two conductors L, of which are brought out through the lower side of the chamber E through bushes M. Connection is made by first stripping the insulation from the two conductors for a suitable distance, soldering the ends of the conductors into the bushes M, and then attaching the bushes to the chamber E by a nut, which is screwed on to the prepared ends of the bushes M, washers being interposed to provide the air-tight joint. In order to reduce surface leakage, the shank portion F, of the terminal conductors, is preferably provided with a petticoat N. It is evident that the improved construction may be employed for mult-core cables having any number of conductors other than two, as may be desired.—*November 7th*, 1929.

LIGHTING AND HEATING.

321,229. August 4th, 1928.—CONTROLLING THE FLOW OF GAS, Gas Accumulator Company (United Kingdom), Ltd., Beacon Works, Brentford, Middlesex, and G. Goodwin.

This apparatus is for providing a pulsating supply of gas to an incandescent burner, in, say, a lighthouse, for producing a flashing light. The supply pipe is shown at A. Part of the gas goes through the needle valve B and actuates the submerged motor wheel C. This gas escapes by the exhaust pipe D and is discharged to atmosphere. The wheel C drives the cam E, which

No 321,229



operates the valve F and produces the pulsation. The screw stop G prevents the valve completely closing, and thus provides a pilot light. The burner is connected with the pipe H. Gas is also admitted to the lower chamber J and its pressure forces paraffin up the column K to submerge the end of the exhaust pipe D. The extent of this submergence will be dependent upon the pressure of the gas, and the back pressure on the motor will also correspond. As a consequence, the speed of the motor is independent of the gas pressure.—*November 4th*, 1929.

MISCELLANEOUS.

321,168. July 31st, 1928.—A SUSPENSION CHAIN FOR ECONOMISER SCRAPERS, &c., J. W. Allen, 24, Smalley-street, Burnley, Lancs., and J. Stanworth, The Woodlands, Rimington, near Gisburn, Yorks.

The object of this invention is to prevent the ingress of air

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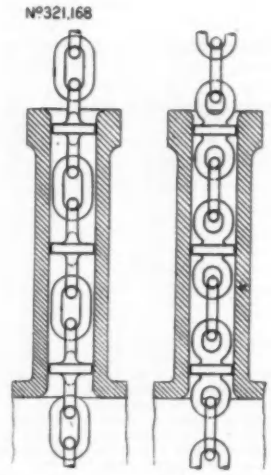

into an economiser or damper setting through the opening where the operating chain passes. Alternate links of the chain are consequently provided with flanges, as shown, which have a sliding fit in the opening trunk. The spacing of the links and the height of the trunk are such that at least two flanged links are always within the trunk.—*October 31st*, 1929.

321,609. January 24th, 1929.—MOULDS FOR CASTING METALS, Metallgesellschaft Aktiengesellschaft, 45, Bockenheimer Anlage, Frankfurt a.M., Germany, and V. M. Goldschmidt, Trondhjemsveien 23, Oslo, Norway, and K. Stenvik.

It has, say the inventors, been found that magnesium orthosilicate is an excellent moulding material, and that, in particular, natural magnesium orthosilicate, such as, for example, olivine—peridotite or dunite—is eminently suitable for this purpose. It is possible to use as moulding sand—for example, olivine rock—which has been reduced to a suitable granular condition, either alone, or, if necessary, mixed with other substances. The granular size preferably should be such that the porosity of the moulding material allows gases to escape freely. It has been found that a porosity of approximately 15 to 30 per cent. of the volume of the pores is suitable for this purpose. If necessary, some quantity of suitable binding medium, such as, for example, talc, magnesite, magnesium, hydroxide, magnesium chloride, clay, iron-containing compounds, &c., may be added to the magnesium orthosilicate sand for the purpose of imparting coherence to the mould. Casting with the use of magnesium orthosilicate, more particularly olivine and the like, offers the great advantage that this moulding material is very resistant to the thermic and also the mechanical action of molten metal.—*November 14th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Line Signalling on the Southern Railway," by Mr. W. Challis. 7.30 p.m.

POLYTECHNIC ENGINEERING SOCIETY.—Fyvie Hall, The Polytechnic, 309, Regent-street, W. 1. Annual conversazione of the Engineering Society. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse: "Italian and Flemish Art—A Contrast," by Mr. E. Cammaerts. 9 p.m.

SATURDAY, DECEMBER 21ST.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—In the College of Technology, Sackville-street, Manchester. "The Short Paper Night Competition." 7 p.m.

SATURDAY, DECEMBER 28TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience, "How Things were Done in Ancient Egypt: i., The Elementary Use of Nature," by Mr. S. R. K. Glanville. 3 p.m.

TUESDAY, DECEMBER 31ST.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience. "How Things were Done in Ancient Egypt: ii., Making a Home," by Mr. S. R. K. Glanville. 3 p.m.

1930.

THURSDAY, JANUARY 2ND.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience. "How Things were Done in Ancient Egypt: iii., Building in Stone," by Mr. S. R. K. Glanville. 3 p.m.

FRIDAY, JANUARY 3RD.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Thomas Lowe Gray Lecture, "Progress in Marine Engineering," by Eng. Vice-Admiral R. W. Skelton. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Speedy Draughtsmanship," by Mr. F. T. Wood. Slides and demonstration. 7.30 p.m.

SATURDAY, JANUARY 4TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience, "How Things were Done in Ancient Egypt: iv., Boats and Furniture," by Mr. S. R. K. Glanville. 3 p.m.

MONDAY, JANUARY 6TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. "Organisation of Public Service Motor Vehicle Repairs and Maintenance Systems," by Mr. W. Lewis Morgan. 7 p.m.

TUESDAY, JANUARY 7TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Roller Bearings," by Mr. T. W. Cooper. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' meeting, Broadgate Café, Coventry. "The Rigid Six-wheeled Vehicle," by Mr. J. R. Harnott. 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience. "How Things were Done in Ancient Egypt: v., The Workshops," by Mr. S. R. K. Glanville. 3 p.m.

TUESDAY TO THURSDAY, JANUARY 7TH TO 9TH.

PHYSICAL SOCIETY AND OPTICAL SOCIETY.—Imperial College of Science, Imperial Institute-road, South Kensington, S.W. Twentieth Annual Exhibition.

THURSDAY, JANUARY 9TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—In the Lecture Theatre of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Christmas Lectures Adapted to a Juvenile Audience. "How Things were Done in Ancient Egypt: vi., Hieroglyphs," by Mr. S. R. K. Glanville. 3 p.m.

MONDAY, JANUARY 13TH.

INSTITUTE OF TRANSPORT.—At the House of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. At this meeting Mr. Ashton Davies will submit for discussion a paper on "The Co-ordination of Transport," instead of upon the subject originally selected, namely, "Air Transport in Relation to Railways." 5.30 p.m.

TUESDAY, JANUARY 14TH.

ASSOCIATION OF EX-SIEMENS' MEN.—A smoking concert will be held at Gatti's Restaurant, King William-street, Strand, W.C. 2.

WEDNESDAY, JANUARY 15TH.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, London, W. 1. Annual general meeting. Presidential address by Mr. Joseph E. Barnard, F.R.S.